

2012 Harley-Davidson VRSC Models
Service Manual

99501-12

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IMPORTANT NOTICE

Harley-Davidson motorcycles conform to all applicable U.S.A. Federal Motor Vehicle Safety Standards and U.S.A. Environmental Protection Agency regulations effective on the date of manufacture.

To maintain the safety, dependability, and emission and noise control performance, it is essential that the procedures, specifications and service instructions in this manual are followed.

Any substitution, alteration or adjustment of emission system and noise control components outside of factory specifications may be prohibited by law.

Harley-Davidson Motor Company

2012 Harley-Davidson VRSC Models Service Manual

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2012 Harley-Davidson VRSC Models Service Manual (99501-12)

Please clip out and mail to:
Service Communications Department
Harley-Davidson Motor Company
P.O. Box 653
Milwaukee, WI USA 53201

NOTES

ABOUT THIS MANUAL

GENERAL

This Service Manual has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the Harley-Davidson product and assist in the performance of basic maintenance and repair. Secondly, it will introduce to the professional Harley-Davidson Technician the latest field-tested and factory-approved major repair methods. We sincerely believe that this Service Manual will make your association with Harley-Davidson products more pleasant and profitable.

HOW TO USE YOUR SERVICE MANUAL

Refer to the table below for the content layout of this manual.

NO.	CHAPTER
1	Maintenance
2	Chassis
3	Engine
4	Fuel System
5	Cooling System
6	Transmission
7	Electrical
A	Appendix A Connector Repair
B	Appendix B Wiring
C	Appendix C ABS
D	Appendix D Valve Lash
E	Appendix E Conversions
F	Appendix F Glossary

Use the TABLE OF CONTENTS (which follows this FOREWORD) and the INDEX (at the back of this manual) to quickly locate subjects. Chapters and topics in this manual are sequentially numbered for easy navigation.

For example, a cross-reference shown as **2.2 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.2 SPECIFICATIONS.

For quick and easy reference, all pages contain a chapter number followed by a page number. For example, **page 3-5** refers to page 5 in Chapter 3.

A number of acronyms and abbreviations are used in this document. See the F.1 GLOSSARY for a list of acronyms, abbreviations and definitions.

PREPARATION FOR SERVICE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Good preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and will reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts. Cleaning will occasionally uncover sources of trouble. Tools, instruments and any parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

NOTES

- *To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- *When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), you must first disarm the security system. Either keep the fob in close proximity to the vehicle, or use DIGITAL TECHNICIAN II (Part No. HD-48650) to disable the security system while the vehicle is being serviced. Activate the system after service is completed.*

SERVICE BULLETINS

In addition to the information presented in this manual, Harley-Davidson Motor Company will periodically issue service bulletins to Harley-Davidson dealers. Service bulletins cover interim engineering changes and supplementary information. Consult the service bulletins to keep your product knowledge current and complete.

USE GENUINE REPLACEMENT PARTS

⚠WARNING

Harley-Davidson parts and accessories are designed for Harley-Davidson motorcycles. Using non-Harley-Davidson parts or accessories can adversely affect performance, stability or handling, which could result in death or serious injury. (00001b)

To achieve satisfactory and lasting repairs, carefully follow the service manual instructions and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. This is your assurance that the parts you are using will fit right, operate properly and last longer.

WARNINGS AND CAUTIONS

Statements in this manual preceded by the following words are of special significance.

⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. (00119a)

⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. (00139a)

NOTICE

NOTICE indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140b)

NOTE

Refers to important information, and is placed in italic type. It is recommended that you take special notice of these items.

Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this manual are effective methods for performing service operations.

⚠WARNING

Always wear proper eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Flying parts could result in death or serious injury. (00496b)

Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended. It is important to note that some warnings against the use of specific service methods, which could damage the motorcycle or render it unsafe, are stated in this manual. However, remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Harley-Davidson could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Harley-Davidson must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized as a result. Failure to do so could result in death or serious injury.

PRODUCT REFERENCES

⚠WARNING

Read and follow warnings and directions on all products. Failure to follow warnings and directions can result in death or serious injury. (00470b)

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be substituted.

Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through SPX Kent-Moore. For ordering information or product returns, warranty or otherwise, visit www.spx.com.

Loctite Sealing and Threadlocking Products

Some procedures in this manual call for the use of Loctite products. If you have any questions regarding Loctite product usage or retailer/wholesaler locations, please contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

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All photographs, illustrations and procedures may not necessarily depict the most current model or component, but are based on the latest production information available at the time of publication.

Since product improvement is our continual goal, Harley-Davidson reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

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NOTES

FASTENER TORQUE VALUES 1.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Air cleaner velocity stack screw	6 Nm	53 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**	1.24 BATTERY MAINTENANCE, Installation/Connection
Bleed Screw	9-11 Nm	80-100 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Caliper pad pin	8.5-11.5 Nm	75-102 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Cam cover fasteners	11 Nm	97 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Cam cover fasteners	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Cam journal caps	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Clutch inspection cover	6-10 Nm	53-88 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Coil fasteners	9.7 Nm	86 **in-lbs**	1.15 SPARK PLUGS AND COIL, Installation
Drain plug, engine oil	35 Nm	25.8 ft-lbs	1.5 MAINTENANCE SCHEDULE, General
Drain plug, radiator	2.3-2.8 Nm	21-24 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Fork and stem pinch bolts	41-48 Nm	30-35 ft-lbs	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Fork stem bracket pinch bolts	41-48 Nm	30-35 ft-lbs	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Front caliper pin	8.5-11.5 Nm	75-102 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Front cylinder secondary cam chain tensioner	100 Nm	74 ft-lbs	1.21 SECONDARY CAM CHAIN, Adjustment
Front engine mount fastener	38 Nm	28 ft-lbs	1.20 VALVE LASH, Lash Adjustment
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Handlebar housing screws	4.0-5.1 Nm	35-45 **in-lbs**	1.11 THROTTLE CABLES, Lubrication
Handlebar switch housing screw	4-5 Nm	35-45 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Headlamp alignment fastener (typical)	4.5-7.5 Nm	40-66 **in-lbs**	1.22 HEADLAMP ALIGNMENT, Headlamp Adjustment
Master cylinder reservoir cover	1.1-1.4 Nm	10-12 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Oil drain plug	35 Nm	25.8 ft-lbs	1.6 ENGINE OIL AND FILTER, Changing Oil and Filter
Radiator hose fasteners	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Radiator side cover fastener	3-4 Nm	27-35 **in-lbs**	1.16 RADIATOR SIDE COVERS, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	1.10 DRIVE BELT AND SPROCKETS, Checking and Adjusting Drive Belt Deflection
Reservoir cap screws	0.7-0.9 Nm	6-8 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Reservoir cap screws	1.1-1.4 Nm	10-12 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**	1.7 AIR CLEANER AND EXHAUST SYSTEM, Installation
Spark plugs	23 Nm	17 ft-lbs	1.5 MAINTENANCE SCHEDULE, General

FASTENER	TORQUE VALUE		NOTES
Spark plugs	23 Nm	17 ft-lbs	1.15 SPARK PLUGS AND COIL, Installation
Spark plugs	23 Nm	17 ft-lbs	1.20 VALVE LASH, Lash Adjustment
Steering stem bolt	9.5 Nm	84 **in-lbs**	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Steering stem bolt	9.5 Nm	84 **in-lbs**	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Velocity stack fasteners	6 Nm	53 **in-lbs**	1.7 AIR CLEANER AND EXHAUST SYSTEM, Installation

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

SERVICING A NEW MOTORCYCLE

⚠WARNING

Perform the service and maintenance operations as indicated in the regular service interval table. Lack of regular maintenance at the recommended intervals can affect the safe operation of your motorcycle, which could result in death or serious injury. (00010a)

Service operations to be performed before customer delivery are specified in the applicable model year predelivery and set-up instructions.

The performance of new motorcycle initial service is required to keep warranty in force and to verify proper emissions systems operation. See 1.5 MAINTENANCE SCHEDULE.

SAFE OPERATING MAINTENANCE

NOTES

- *Do not attempt to tighten engine head bolts or engine damage may result.*
- *During the initial break-in period, use only GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. Failure to use the recommended oil will result in improper break-in of the engine cylinders and piston rings.*

A careful check of certain equipment is necessary after periods of storage, and frequently between regular service intervals, to determine if additional maintenance is required.

Check:

1. Tires for correct pressure, excessive wear or any signs of tire damage.
2. Drive belt tension and condition.
3. Brakes, steering and throttle for responsiveness.
4. Brake fluid level and condition. Hydraulic lines and fittings for leaks. Also, check brake pads and discs for wear.
5. Cables for fraying, crimping and free operation.
6. Engine oil and transmission fluid levels.
7. Headlamp, auxiliary lamp, tail lamp, brake lamp, horn and turn signal operation.

SHOP PRACTICES

Repair Notes

General maintenance practices are given in this section.

NOTES

- *Repair = Disassembly/Assembly.*
- *Replacement = Substitute a **new** part for existing component.*

All special tools and torque values are noted at the point of use.

All required parts or materials can be found in the parts catalog.

Safety

Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. Protect yourself and bystanders with approved eye protection. Don't just do the job - do the job safely.

Removing Parts

Always consider the weight of a part when lifting. Use a hoist whenever necessary. Do not lift heavy parts by hand. A hoist and adjustable lifting beam or sling are needed to remove some parts. The lengths of multiple chains or cables from the hoist to the part should be equal and parallel and should be positioned directly over the center of the part. Be sure that no obstructions will interfere with the lifting operation. Never leave a part suspended in mid-air.

⚠WARNING

Be sure to check capacity rating and condition of hoists, slings, chains and cables before use. Exceeding capacity ratings or using lifting devices that are in poor condition can lead to an accident, which could result in death or serious injury. (00466c)

Always use blocking or proper stands to support the part that has been hoisted. If a part cannot be removed, verify that all bolts and attaching hardware have been removed. Check to see if any parts are in the way of the part being removed.

When removing hoses, wiring or tubes, always tag each part to verify proper installation.

Cleaning

If parts are to be reused, follow good shop practice and thoroughly clean the parts before assembly. Keep all dirt out of parts to promote better component operation and longer life. Seals, filters and covers are used in this vehicle to keep out extraneous dirt and dust. These items must be kept in good condition to guarantee satisfactory operation.

When instructed to clean fastener threads or threaded holes, proceed as follows: Clean all threadlocking material from fastener threads and threaded holes. Use a wire brush to clean fastener threads. Use a thread chaser or other suitable tool to clean threaded holes. Use PJ1 cleaner or equivalent to remove all traces of oil and contaminants from threads. Clean all threaded holes with low pressure compressed air.

Clean and inspect all parts as they are removed. Be sure all holes and passages are clean and open. After cleaning, cover all parts with clean lint-free cloth, paper or other material. Be sure the part is clean when it is installed.

Always clean around lines or covers before they are removed. Plug, tape or cap holes and openings to keep out dirt, dust and debris.

Always verify cleanliness of blind holes before assembly. Tightening a screw with dirt, water or oil in the hole can cause castings to crack or break.

Disassembly and Assembly

Always assemble or disassemble one part at a time. Do not work on two assemblies simultaneously. Be sure to make all necessary adjustments. Check your work when finished to be sure that everything is done.

Operate the vehicle to perform any final check or adjustments. If all is correct, the vehicle is ready to go back to the customer.

Checking Torques on Fasteners

Attempt to turn the fastener using a torque wrench set to the minimum torque specification for that fastener. If the fastener does not rotate, the fastener torque has been maintained. If the fastener rotates, remove it to determine if it has a thread-locking agent.

If it has a threadlocking agent, clean all threadlocking material from the threaded hole. Replace the fastener with a **new** one or clean the original fastener threads and apply the appropriate threadlocking product (see the specific procedure). Install and tighten the fastener to specification.

If the fastener does not use a threadlocking agent, install and tighten it to specification.

Magnetic Parts Trays

Magnetic parts trays are common in the service facility because they are convenient and can keep parts from becoming lost during a repair procedure. However, hardened steel parts can become magnetized when held in magnetic parts trays.

Metal fragments from normal wear are ordinarily washed away by the engine oil and trapped in the oil filter or by the magnetic drain plug. Magnetized parts in the engine can retain these fragments, potentially causing accelerated engine wear and damage.

Parts that will be returned to service inside the vehicle's powertrain such as gears, thrust washers and especially bearings should never be kept in magnetic parts trays.

REPAIR AND REPLACEMENT PROCEDURES

Hardware and Threaded Parts

Install thread repair inserts when threaded holes in castings are stripped, damaged or not capable of withstanding specified torque.

Replace bolts, nuts, studs, washers, spacers and small common hardware if missing or damaged. Clean up or repair minor thread damage with a suitable tap or die.

Replace all damaged or missing lubrication fittings.

Use Teflon pipe sealant or LOCTITE 565 PIPE SEALANT WITH TEFLON on pipe fitting threads.

Threadlocking Agents

Always follow specific service manual procedures when working with fasteners containing preapplied threadlocking agents when fastener replacement is recommended. When re-using fasteners containing threadlocking agents, be sure to completely remove all existing threadlocking agent from fastener threads with a wire brush or wire wheel. Also, be sure to remove residual threadlocking agent from fastener hole using an appropriate thread chasing device and compressed air. Always use the recommended threadlocking agent for the specific procedure.

Wiring, Hoses and Lines

Hoses, clamps, electrical wiring, electrical switches or fuel lines if they do not meet specifications.

Instruments and Gauges

Replace damaged or defective instruments and gauges.

Bearings

Anti-friction bearings must be handled in a special way. To keep out dirt and abrasives, cover the bearings as soon as they are removed from the package.

When bearings are installed against shoulders, be sure that the chamfered side of the bearing always faces the shoulder. Lubricate bearings and all metal contact surfaces before pressing into place. Only apply pressure on the part of the bearing that makes direct contact with the mating part. Install bearings with numbered side facing out.

Always use the proper tools and fixtures for removing and installing bearings.

Only remove bearings if necessary. Removal usually damages bearings requiring them to be replaced with **new** parts.

Bushings

Do not remove a bushing unless damaged, excessively worn or loose in its bore. Press out bushings that must be replaced.

When pressing or driving bushings, be sure to apply pressure in line with the bushing bore. Use a bearing/bushing driver or a bar with a smooth, flat end. Never use a hammer to drive bushings.

Inspect the bushing and the mating parts for oil holes before installation, and be sure all oil holes are properly aligned during installation.

Gaskets

Always discard gaskets after removal. Replace with **new** gaskets. Never use the same gasket twice. Be sure that gasket holes match up with holes in the mating part. But be aware that sections of a gasket may be used to seal passages.

Lip-Type Seals

Lip seals are used to seal oil or grease and are usually installed with the sealing lip facing the contained lubricant. Seal orientation, however, may vary under different applications.

Seals should not be removed unless necessary. Only remove seals if required to gain access to other parts or if seal damage or wear dictates replacement.

Leaking oil or grease usually means that a seal is damaged. Replace leaking seals to prevent overheated bearings.

Always discard seals after removal. Do not use the same seal twice.

O-Rings (Pre-Formed Packings)

Always discard O-rings after removal. Replace with **new** O-ring. To prevent leaks, lubricate the O-rings before installation. Apply the same type of lubricant as that being sealed. Be sure

that all gasket, O-ring and seal mating surfaces are thoroughly clean before installation.

Gears

Always check gears for damaged or worn teeth.

Remove burrs and rough spots with a honing stone or crocus cloth before installation.

Lubricate mating surfaces before pressing gears on shafts.

Shafts

If a shaft does not come out easily, check that all nuts, bolts or retaining rings have been removed. Check to see if other parts are in the way before using force to remove.

Shafts fitted to tapered splines should be very tight. If shafts are not tight, disassemble and inspect tapered splines. Discard parts that are worn. Be sure tapered splines are clean, dry and free of burrs before putting them in place. Press mating parts together tightly.

Clean all rust from the machined surfaces of **new** parts.

Part Replacement

Always replace worn or damaged parts with **new** parts.

Exhaust System Leakage

In the event of an exhaust system leak at a muffler or header pipe connection location, disassemble and clean all mating surfaces. Replace any damaged components. If the leak still exists, disassemble and repair the leak by applying a bead of Permatex Ultra Copper or LOCTITE 5920 Flange Sealant (or an equivalent oxygen sensor/catalyst-safe alternative). Assemble components, wipe off any excess sealant and allow adequate curing time following sealant product instructions before operating vehicle.

CLEANING

Part Protection

Before cleaning, protect rubber parts (such as hoses, boots and electrical insulation) from cleaning solutions. Use a grease-proof barrier material. Remove the rubber part if it cannot be properly protected.

Cleaning Process

Any cleaning method may be used as long as it does not result in parts damage. Thorough cleaning is necessary for proper parts inspection. Strip rusted paint areas to bare metal before priming and repainting.

Rust or Corrosion Removal

Remove rust and corrosion with a wire brush, abrasive cloth, sand blasting, vapor blasting or rust remover. Use buffing crocus cloth on highly polished parts that are rusted.

Bearings

Wash bearings in a non-flammable petroleum cleaning solution. Never use a solution that contains chlorine. Knock out packed lubricant by tapping the bearing against a wooden block. Wash bearings again.

⚠WARNING

Using compressed air to "spin dry" bearings can cause bearing to fly apart, which could result in death or serious injury. (00505b)

Cover bearings with a clean shop towel and allow to air dry. Do not spin bearings while they are drying. Never use compressed air to dry bearings.

When dry, coat bearings with clean oil. Wrap bearings in clean paper.

TOOL SAFETY

Air Tools

- Always use approved eye protection equipment when performing any task using air-operated tools.
- On all power tools, use only recommended accessories with proper capacity ratings.
- Do not exceed air pressure ratings of any power tools.
- Bits should be placed against work surface before air hammers are operated.
- Disconnect the air supply line to an air hammer before attaching a bit.
- Never point an air tool at yourself or another person.
- Protect bystanders with approved eye protection.

Wrenches

- Never use an extension on a wrench handle.
- If possible, always pull on a wrench handle and adjust your stance to prevent a fall if something suddenly releases.
- Always keep the wrench squarely installed on the fastener.
- Never use a hammer on any wrench other than a STRIKING FACE wrench.
- Discard any wrench with damaged or battered points.
- Never use a pipe wrench to bend, raise or lift a pipe.

Pliers/Cutters/Pry Bars

- Plastic- or vinyl-covered pliers handles are not intended to act as insulation. Do not use them on live electrical circuits.
- Do not use pliers or cutters for cutting hardened wire unless they were designed for that purpose.
- Always cut at right angles.
- Do not use any pry bar as a chisel, punch or hammer.

Hammers

- Never strike a hammer against a hardened object, such as another hammer.
- Always grasp a hammer handle firmly, close to the end.
- Strike the object with the full face of the hammer.
- Never work with a hammer which has a loose head or cracked handle.
- Discard hammer if face is chipped or mushroomed.
- Wear approved eye protection when using striking tools.
- Protect bystanders with approved eye protection.

Punches/Chisels

- Never use a punch or chisel with a chipped or mushroomed end. Dress mushroomed chisels and punches with a grinder.
- Hold a chisel or a punch with a tool holder if possible.
- When using a chisel on a small piece, clamp the piece firmly in a vise and chip toward the stationary jaw.
- Always wear approved eye protection when using these tools.
- Protect bystanders with approved eye protection.

Screwdrivers

- Do not use a screwdriver for prying, punching, chiseling, scoring or scraping.
- Use the right type of screwdriver for the job. Match the tip of a screwdriver to the fastener.
- Do not interchange POZIDRIV, PHILLIPS or REED AND PRINCE screwdrivers.
- Screwdriver handles are not intended to act as insulation. Do not use them on live electrical circuits.
- Do not use a screwdriver with rounded edges because it will slip. Redress with a grinder.

Ratchets and Handles

- Periodically clean and lubricate ratchet mechanisms with a light grade oil. Do not replace parts individually. Ratchets should be rebuilt with the entire contents of service kit.
- Never hammer on a ratchet or put a pipe extension on a ratchet handle for added leverage.
- Always support the ratchet head when using socket extensions, but do not put your hand on the head or you may interfere with the action of its reversing mechanism.
- When breaking a fastener loose, apply a small amount of pressure as a test to be sure the ratchet's gear wheel is engaged with the pawl.

Sockets

- Never use hand sockets on power or impact wrenches. Select only impact sockets for use with air or electric impact wrenches.
- Select the right size socket for the job.
- Always keep the wrench or socket squarely on the fastener.
- Replace sockets showing cracks or wear.
- Keep sockets clean.
- Always use approved eye protection when using power or impact sockets.

Storage Units

- Do not open more than one loaded drawer at a time. Close each drawer before opening another to prevent the cabinet from unexpectedly tipping over.
- Close lids and lock drawers and doors before moving storage units.
- Do not pull on a tool cabinet. Always push tool cabinets in front of you.
- Set the brakes on the locking casters after the cabinet has been rolled into position.

DIGITAL TECHNICIAN HARLEY-DAVIDSON

FUEL AND OIL 1.3

FUEL

Always use a good quality unleaded gasoline. Octane ratings are usually found on the pump. Refer to Table 1-1.

⚠WARNING

Avoid spills. Slowly remove filler cap. Do not fill above bottom of filler neck insert, leaving air space for fuel expansion. Secure filler cap after refueling. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00028a)

⚠WARNING

Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)

Modern service station pumps dispense a high flow of gasoline into a motorcycle fuel tank making air entrapment and pressurization a possibility.

Table 1-1. Octane Ratings

SPECIFICATION	RATING
Pump Octane (R+M)/2	91 (95 RON)

GASOLINE BLENDS

Your motorcycle was designed to get the best performance and efficiency using unleaded gasoline. Most gasoline is blended with alcohol and/or ether to create oxygenated blends. The type and amount of alcohol or ether added to the fuel is important.

NOTICE

Do not use gasoline that contains methanol. Doing so can result in fuel system component failure, engine damage and/or equipment malfunction. (00148a)

- Gasoline containing METHYL TERTIARY BUTYL ETHER (MTBE): Gasoline/MTBE blends are a mixture of gasoline and as much as 15% MTBE. Gasoline/MTBE blends can be used in your motorcycle.
- ETHANOL fuel is a mixture of ethanol (Grain alcohol) and unleaded gasoline. While ethanol does have an impact on fuel mileage, fuels with an ethanol content of up to 10% may be used in your motorcycle without affecting vehicle performance. U.S. EPA regulations currently indicate that fuels with 15% ethanol (E15) are restricted from use in motorcycles at the time of this publication. Motorcycles delivered in some countries are calibrated to operate with higher ethanol concentrations to meet the fuel standards in those countries.
- REFORMULATED OR OXYGENATED GASOLINES (RFG): Reformulated gasoline is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline, leaving fewer tailpipe emissions. They are also formulated to evaporate less when you are filling your tank. Reformulated gasolines use additives to oxygenate the gas. Your motorcycle will run normally using this type of gas and Harley-Davidson recommends you use it when possible, as an aid to cleaner air in our environment.
- Do not use race gas. Use of these fuels will damage the fuel system.
- Harley-Davidson recommends using SCREAMIN' EAGLE SUPER OCTANE BOOST to raise fuel octane. This is the only octane booster that has been extensively tested and approved for use with Harley-Davidson engines and components.

Some gasoline blends might adversely affect the starting, driveability or fuel efficiency of the motorcycle. If any of these problems are experienced, try a different brand of gasoline or gasoline with a higher octane blend.

ENGINE LUBRICATION

⚠CAUTION

Prolonged or repeated contact with used motor oil may be harmful to skin and could cause skin cancer. Promptly wash affected areas with soap and water. (00358b)

⚠CAUTION

If swallowed, do not induce vomiting. Contact a physician immediately. In case of contact with eyes, immediately flush with water. Contact a physician if irritation persists. (00357c)

NOTICE

Do not switch lubricant brands indiscriminately because some lubricants interact chemically when mixed. Use of inferior lubricants can damage the engine. (00184a)

Engine oil is a major factor in the performance and service life of the engine. Always use the proper grade of oil for the lowest temperature expected before the next scheduled oil change. Your authorized dealer has the proper oil to suit your requirements. Refer to Table 1-2.

This motorcycle was originally equipped with Genuine H-D 360 Multi-Grade 20W50 engine oil, and is the preferred oil under normal operating conditions. If operation under extreme cold or heat are expected, refer to Table 1-2 for alternative choices.

If H-D 360 is not available, the second choice would be to add an oil certified for diesel engines. Acceptable diesel engine oil designations include: CH-4, CI-4 and CJ-4. The preferred viscosities for the diesel engine oils, in descending order are: 20W50, 15W40 and 10W40.

At the first opportunity, see an authorized dealer to change back to 100 percent Harley-Davidson oil.

Table 1-2. Recommended Engine Oils

TYPE	VISCOSITY	RATING	LOWEST AMBIENT TEMPERATURE	COLD WEATHER STARTS BELOW 10 °C (50 °F)
Screamin' Eagle SYN3 Synthetic Motorcycle Lubricant	SAE 20W50	HD 360	Above 4 °C (40 °F)	Excellent
Screamin' Eagle Synthetic Blend Motorcycle Lubricant	SAE 20W50	HD 360	Above 4 °C (40 °F)	Good
Genuine H-D 360 Multi-grade	SAE 20W50	HD 360	Above 4 °C (40 °F)	Good
Multi-grade (oil certified for use in diesel engines)	SAE 10W40	SH, CH-4, CI-4, CJ-4	Below 4 °C (40 °F)	Excellent

WINTER LUBRICATION

In colder climates, the engine oil should be changed often. If motorcycle is frequently used for trips less than 24 km (15 mi), in ambient temperatures below 16 °C (60 °F), reduce oil change intervals to 2400 km (1500 mi).

NOTE

The further below freezing the temperature drops, the shorter the oil change interval should be.

Water vapor is a normal by-product of combustion in any engine. During cold weather operation, some of the water vapor condenses to liquid form on the cool metal surfaces inside the engine. In freezing weather this water will become slush or ice and, if allowed to accumulate too long, may block the oil lines and cause damage to the engine.

If the engine is run frequently and allowed to thoroughly warm up, most of this water will become vapor again and will be blown out through the crankcase breather.

If the engine is not run frequently and allowed to thoroughly warm up, this water will accumulate, mix with the engine oil and form a sludge that is harmful to the engine.

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BULB REQUIREMENTS 1.4

GENERAL

Refer to Table 1-3. This table gives the location and bulb requirements for Harley-Davidson VRSC motorcycles.

NOTES

- *All VRSC speedometers, tachometers indicator lamps and odometers are illuminated with LEDs.*
- *LEDs are non-repairable. The entire instrument cluster must be replaced if an LED fails.*

Table 1-3. Bulb Chart

LAMP	DESCRIPTION (ALL LAMPS 12 VOLT)	BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	H-D PART NUMBER
Headlamp	low beam	1	4.30	68881-01
	high beam	1	5.10	67717-01
Tail and stop lamp VRSCF	Illuminated with LEDs. Replace entire assembly upon failure.			
License plate illumination VRSCF	Domestic: Illuminated with LEDs. Replace entire assembly upon failure.			
	International	2	0.32	53436-97
Tail and stop lamp VRSCDX and VRSCDX ANV	Illuminated with LEDs. Replace entire assembly upon failure.			
License plate illumination VRSCDX and VRSCDX ANV	International	2	0.32	53436-97
Turn signal lamp VRSCDX and VRSCDX ANV	front/running	2	2.25/0.59	68168-89A
	rear	2	2.25/0.59	68168-89A
	front/running international	2	1.75	68163-84
	rear international	2	1.75	68163-84
Turn signal lamp VRSCF	front/running	Illuminated with LEDs. Replace entire assembly upon failure.		
	rear	Illuminated with LEDs. Replace entire assembly upon failure.		
Instrument cluster	Illuminated with LEDs. Replace entire assembly upon failure.			

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MAINTENANCE SCHEDULE 1.5

GENERAL

FASTENER	TORQUE VALUE	
Drain plug, engine oil	35 Nm	25.8 ft-lbs
Drain plug, radiator	2.3-2.8 Nm	21-24 **in-lbs**
Bleed Screw	9-11 Nm	80-100 **in-lbs**
Clutch inspection cover	6-10 Nm	53-88 **in-lbs**
Master cylinder reservoir cover	1.1-1.4 Nm	10-12 **in-lbs**
Air cleaner velocity stack screw	6 Nm	53 **in-lbs**
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**
Handlebar switch housing screw	4-5 Nm	35-45 **in-lbs**
Spark plugs	23 Nm	17 ft-lbs
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**

The table below lists the periodic maintenance requirements for VRSC model motorcycles. If you are familiar with the procedures, refer to the table for the recommended service interval. If necessary, refer to the quick reference table (Table 1-5.) for the required specifications.

If more detailed information is needed, turn to the sections which follow for step-by-step instructions.

Also, throughout this manual, you will be instructed to use various lubricants, greases and sealants. Refer to Table 1-6. for the correct part numbers of these items.

Table 1-4. Regular Service Intervals: 2012 VRSC Models

ITEM SERVICED	PROCEDURE	1000 MI 1600 KM	5000 MI 8000 KM	10,000 MI 16,000 KM	15,000 MI 24,000 KM	20,000 MI 32,000 KM	25,000 MI 40,000 KM	30,000 MI 48,000 KM	NOTES
Engine oil and filter	Replace	X	X	X	X	X	X	X	3, 6
Oil lines and brake system	Inspect for leaks, contact or abrasion	X	X	X	X	X	X	X	1, 3
Air cleaner	Inspect, service as required		X	X	X	X	X	X	6
Tires	Check pressure, inspect tread	X	X	X	X	X	X	X	3
Clutch fluid	Check level and condition	X	X	X	X	X	X	X	4, 6
Drive belt and sprockets	Inspect, adjust belt	X	X	X	X	X	X	X	1
Throttle, brake and clutch controls	Check, adjust and lubricate	X	X	X	X	X	X	X	1
Jiffy stand	Inspect and lubricate	X	X	X	X	X	X	X	1
Fuel filter cartridge		Replace every 160,000 kilometers (100,000 miles)							
Brake fluid	Inspect sight glass	X	X	X	X	X	X	X	4
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	X	
Spark plugs	Replace							X	7
Electrical equipment and switches	Check operation	X	X	X	X	X	X	X	
Front fork oil		Replace fork oil and inspect every 80,000 kilometers (50,000 miles)							1
Steering head bearings	Adjust	X				X		X	1, 2
Valve lash		Inspect valve lash every 24,000 kilometers (15,000 miles) and adjust if necessary							1, 5
Cooling system	Inspect; check clamps for tightness, check coolant freeze point	X		X		X		X	1
Coolant		Replace every 48,000 kilometers (30,000 miles)							1
Radiator	Clean	X	X	X	X	X	X	X	
Critical fasteners	Check tightness	X		X		X			1
Battery		Check battery and clean connections annually.							
Exhaust system	Inspect for leaks, cracks, and loose or missing fasteners or heat shields	X	X	X	X	X	X	X	3, 6

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Table 1-4. Regular Service Intervals: 2012 VRSC Models

ITEM SERVICED	PROCEDURE	1000 MI 1600 KM	5000 MI 8000 KM	10,000 MI 16,000 KM	15,000 MI 24,000 KM	20,000 MI 32,000 KM	25,000 MI 40,000 KM	30,000 MI 48,000 KM	NOTES
Road test	Verify component and system functions	X	X	X	X	X	X	X	
NOTES:	1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified. 2. Disassemble, inspect and lubricate every 48,000 kilometers (30,000 miles). 3. Perform annually or at specified intervals, whichever comes first. 4. Change DOT 4 hydraulic brake/clutch fluid and flush system every two years. 5. Could vary with frequency of operation and riding style. 6. Perform maintenance more frequently in severe riding conditions (such as extreme temperatures, dusty environments, mountainous or rough roads, long storage conditions, short runs and heavy stop/go traffic). 7. Perform every two years or at specified intervals, whichever comes first.								

Table 1-5. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque, engine oil	35 Nm (25.8 ft-lbs)
	Oil capacity	5.0 qt. (4.7 L) with filter
	Oil Level	Motorcycle upright. Remove dipstick, wipe off and thread back in. Remove and verify level.
	Filter	Hand tighten 2/3-1 full turn after gasket contact
Radiator and coolant	Drain plug torque, radiator	2.3-2.8 Nm (21-24 **in-lbs**)
	System capacity	2.54 qt. (2.4 L)
Clutch adjustment	Free play at adjuster screw	Hydraulic
	Bleed screw Torque	9-11 Nm (80-100 **in-lbs**)
	Free play at hand lever	4 mm (5/32 in)
	Clutch inspection cover torque	6-10 Nm (53-88 **in-lbs**)
Transmission lubricant	Lubricant level	Wet sump engine with integral transmission, wet clutch. See engine oil.
Tire condition and pressure	Pressure for solo rider	Front: 248 kPa (36 psi) Rear: 290 kPa (42 psi)
	Pressure for rider and passenger	Front: 248 kPa (36 psi) Rear: 290 kPa (42 psi)
	Wear	Replace tire if 0.8 mm (1/32 in) or less of tread pattern remains
Steering head bearings	Lubricant for steering head bearings	SPECIAL PURPOSE GREASE
Brake fluid reservoir level (Check sight glass. If fluid is low, remove reservoir cover and re-check.)	DOT 4	DOT 4 BRAKE FLUID
	Proper fluid level front	5 mm (13/64 in) from the top
	Proper fluid level rear	12.7 mm (0.5 in) below gasket surface
	Master cylinder reservoir cover torque	1.1-1.4 Nm (10-12 **in-lbs**)
Brake pads and discs	Minimum brake pad thickness	0.4 mm (0.016 in) Wear indicator lines in pad material must be visible
	Minimum brake disc thickness	4.5 mm (0.177 in)
Drive belt	Upward measurement force applied at midpoint of bottom belt strand	4.5 kg (10 lb.)
	Belt deflection with no rider on motorcycle	6-10 mm (0.236-0.394 in)
Air cleaner	Air cleaner velocity stack screw torque	6 Nm (53 **in-lbs**)
	Air cleaner cover wing nut torque	Turn wing nut 2.5-3 turns after contact

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Table 1-5. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Throttle cables	Lubricant	HARLEY LUBE
	Handlebar clamp screw torque	6.8-9.0 Nm (60-80 **in-lbs**)
	Handlebar switch housing screw torque	4-5 Nm (35-45 **in-lbs**)
Spark plugs	Type	10R12A
	Gap	0.89 mm (0.035 in)
	Torque	23 Nm (17 ft-lbs) with anti-seize applied to threads
Engine idle speed	Idle speed	1250 RPM Nominal, non-adjustable
Front fork oil	Type	TYPE "E" HYDRAULIC FORK OIL
Battery	Lubricant	ELECTRICAL CONTACT LUBRICANT
	Battery terminal torque	6.8-7.9 Nm (60-70 **in-lbs**)

Table 1-6. Lubricants, Greases, Sealants

ITEM	PART NUMBER	PACKAGE
Anti-Seize Lubricant	98960-97	1 oz squeeze tube
CCI #20 Brake Grease	42830-05	squeeze packet (included in master cylinder rebuild kit)
G40M Brake Grease	42820-04	squeeze packet
Dow Corning Moly 44 Grease	94674-99	2 cc packet
DOT 4 Brake Fluid	99953-99A	12 oz bottle
Electrical Contact Lubricant	99861-02	1 oz squeeze tube
Formula+ Transmission and Primary Chaincase Lubricant	99851-05	1 qt bottle
Genuine Harley-Davidson H-D 360 20W50 Motorcycle Oil	99816-2050/00QT	1 qt bottle
Screamin' Eagle Synthetic Blend Motorcycle Engine Oil 20W50	99813-09	1 qt bottle
Screamin' Eagle SYN3 Full Synthetic Motorcycle Lubricant 20W50	99824-03/00QT	1 qt bottle
Harley-Davidson High Performance Sealant - Gray	99650-02	1.9 oz squeeze tube
Hylomar Gasket and Thread Sealant	99653-85	3.5 oz tube
Loctite 565 Thread Sealant	99818-97	6 mL tube
Loctite 770 Prism Primer		
Loctite 411 Prism Instant Adhesive		
Loctite 420 Super Bonder Adhesive		
Loctite 7649 Cleaner/Primer	98968-99	1.75 oz bottle
Loctite 222 Low Strength Threadlocker and Sealant (purple)	99811-97	6 mL tube
Loctite 243 Medium Strength Threadlocker and Sealant (blue)	99642-97	6 mL tube
	11100005	50 mL bottle
Loctite 246 Medium Strength/High Temperature Threadlocker (blue)		
Loctite 262 High Strength Threadlocker and Sealant (red)	94759-99	6 mL tube
	11100006	50 mL bottle
Loctite 271 High Strength Threadlocker (red)	99671-97	6 mL tube

Table 1-6. Lubricants, Greases, Sealants

ITEM	PART NUMBER	PACKAGE
Loctite 272 High Strength/High Temperature Thread-locker and Sealant (red/orange)	98618-03	10 mL bottle
Screamin' Eagle Assembly Lube	94971-09	4 oz bottle
Special Purpose Grease	99857-97A	14 oz cartridge
Wheel Bearing Grease	99855-89	1 lb can
	99856-92	14 oz cartridge
Harley® Lube	94968-09	1/4 oz needle dispenser
Type "E" Hydraulic Fork Oil	99884-80	16 oz bottle
Big Piston Fork Oil (Sportster XR only)	99885-10	16 oz bottle
Harley-Davidson Leather Dressing	98261-91V	6 oz can
Harley-Davidson Adhesive (Griplock)	99839-95	10 g tube
RTV Silicone Sealer	99650-02	1.9 oz tube
3M General Purpose Adhesive Remover		15 oz. Aerosol
3M 847 Adhesive	021200-19718	5 oz tube
Genuine Harley-Davidson Extended Life Antifreeze and Coolant (VRSC only)	99822-02	1 gal container

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ENGINE OIL AND FILTER 1.6

CHECKING AND ADDING OIL

NOTICE

Oil level cannot be accurately measured on a cold engine. For pre-ride inspection with the motorcycle upright (not leaning on jiffy stand) on level ground, the oil should register approximately at the midpoint of the cross-hatch area on the dipstick when the engine is cold. Do not add oil to bring the level to the full mark on a cold engine. (00186b)

NOTE

This engine has a wet sump, an integral transmission, gear driven primary drive and wet clutch. This design allows engine oil in the sump to be used to lubricate the engine, transmission and primary drive. The clutch and primary drive are located on the right side of the engine.

Cold Engine Oil Level Check

Check engine oil level with engine **COLD** as follows:

1. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
2. See Figure 1-1 or Figure 1-2. Remove the oil filler cap (with attached dipstick) by turning the filler cap counter-clockwise. Remove the filler cap and dipstick and wipe the dipstick clean.
3. Install the filler cap into the engine. Make sure the cap is fully seated on the crankcase.
4. See Figure 1-3. Remove the filler cap again and check the oil level on the dipstick.
5. If the oil level is below the midpoint of the cross-hatch area on the dipstick, add enough Harley-Davidson oil to bring the level up to the midpoint of the cross-hatch area shown.

NOTICE

Do not operate the engine when the oil level is below the add mark on the dipstick at operating temperature. Engine damage will result. (00187b)

Hot Engine Oil Level Check

Check engine oil level with **engine at normal operating temperature as follows:**

1. Stop engine and allow oil to drain into sump for **about three minutes.**
2. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
3. See Figure 1-1 or Figure 1-2. Remove filler cap (with attached dipstick) located at front of engine on left side. Remove filler cap and dipstick and wipe dipstick clean.
4. Install filler cap into engine. Make sure cap is fully seated on crankcase.

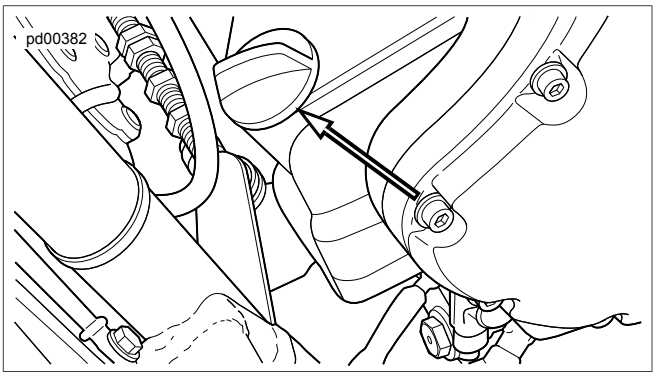


Figure 1-1. Dipstick Filler Cap

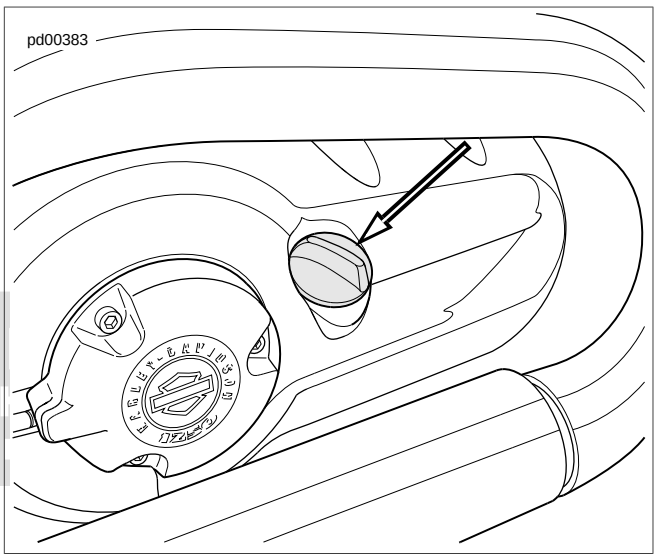


Figure 1-2. Dipstick Filler Cap (VRSCF only)

5. Remove filler cap and check oil level on dipstick.

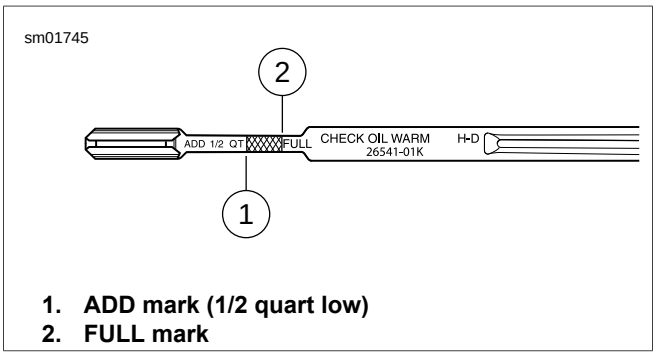
NOTICE

To avoid over-filling the oil sump, wait approximately three minutes after adding oil before checking the oil level with the dipstick. An over-filled sump can cause engine damage. (00188a)

6. If oil level is below FULL mark on the cross-hatched band of the dipstick, add enough Harley-Davidson oil to bring level up to the FULL mark. Observe NOTICE stated below.

NOTICE

Do not allow hot oil level to fall below Add/Fill mark on dipstick. Doing so can result in equipment damage and/or equipment malfunction. (00189a)



1. **ADD mark (1/2 quart low)**
2. **FULL mark**

Figure 1-3. Dipstick

NOTE

Cross hatched band of dipstick indicates 0.47 liter (1/2 quart) of Harley-Davidson oil.

CHANGING OIL AND FILTER

PART NUMBER	TOOL NAME
HD-44067	OIL FILTER WRENCH

FASTENER	TORQUE VALUE	
Oil drain plug	35 Nm	25.8 ft-lbs

NOTICE

Use Harley-Davidson oil filter wrench for filter removal. This tool can prevent damage to crankshaft position sensor and/or sensor cable. (00192b)

NOTES

- *If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.*
- *VRSC models are shipped from the factory with GENUINE HARLEY- DAVIDSON H-D 360 MOTORCYCLE OIL 20W50.*
- *VRSC models come equipped from the factory with a premium 10 micron synthetic media oil filter. These are the only recommended replacement filters.*

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. See Figure 1-1. Remove the oil filler plug/dipstick on left side.
3. See Figure 1-4. Remove the engine oil drain plug at front of oil pan on left side. Allow oil to drain into a suitable container.

NOTE

Lower radiator mounting bracket can be loosened and moved forward slightly to improve access to oil filter.

4. Remove the oil filter using the OIL FILTER WRENCH (Part No. HD-44067). Clean the oil filter mount flange of any old gasket material.
5. See Figure 1-6. Lube the gasket on **new** oil filter with engine oil and install **new** filter. Hand tighten oil filter 2/3 to 1 turn after gasket contacts filter mounting surface.
6. See Figure 1-4. Install oil drain plug.
 a. Inspect oil drain plug for damage. Replace if required. Wipe any foreign material from plug.
 b. Install drain plug. Tighten to 35 Nm (25.8 ft-lbs).
7. See Figure 1-1. Select the grade of oil for the lowest temperature expected before next oil change. Refer to Table 1-7.

NOTE

The position of the motorcycle when draining oil affects the amount of residual oil in the crankcase. Do not overfill.

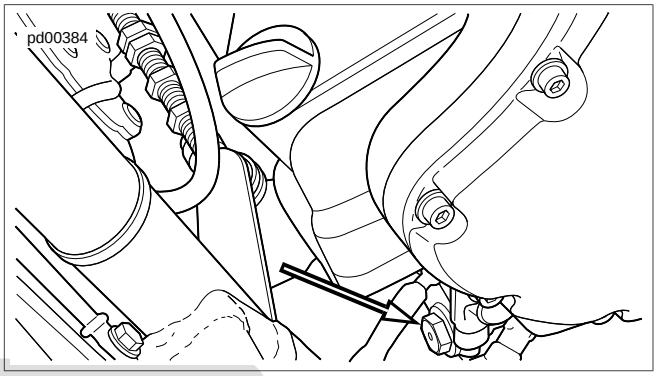


Figure 1-4. Oil Drain Plug (typical)

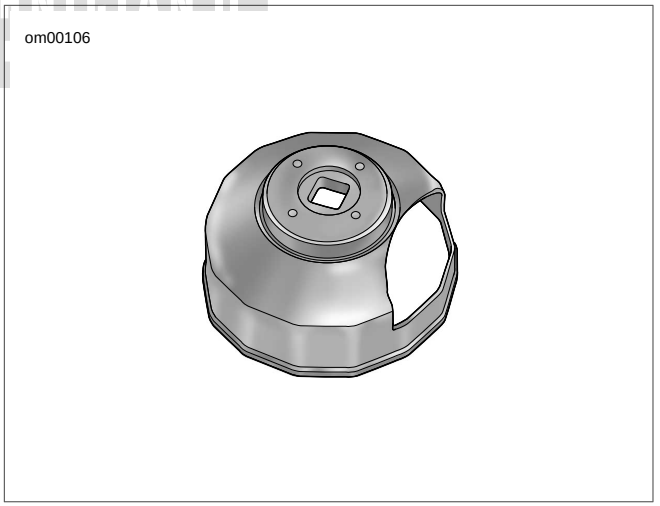


Figure 1-5. Oil Filter Wrench (Part No. HD-44067)

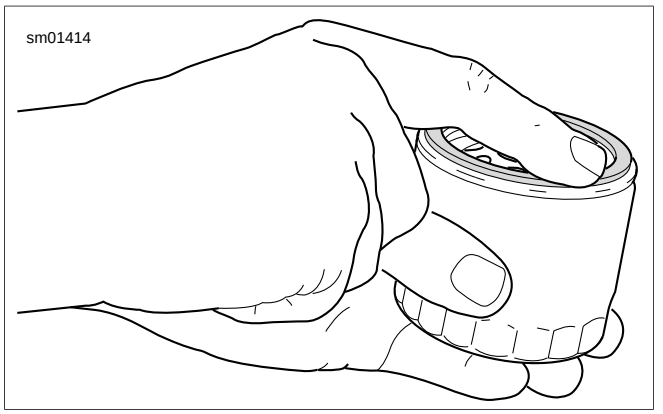


Figure 1-6. Lubricating New Oil Filter Gasket

8. Fill engine and perform a cold engine oil level check. See 1.6 ENGINE OIL AND FILTER.

NOTE

Maximum capacity of oil system is 4.7 L (5 qt.).

9. Start engine and carefully check for oil leaks around drain plug and oil filter.
10. Perform a complete hot engine oil level check. See Hot Engine Oil Level Check in 1.6 ENGINE OIL AND FILTER.

Table 1-7. Recommended Engine Oils

TYPE	VISCOSITY	RATING	LOWEST AMBIENT TEMPERATURE	COLD WEATHER STARTS BELOW 10 °C (50 °F)
Screamin' Eagle SYN3 Synthetic Motorcycle Lubricant	SAE 20W50	HD 360	Above 4 °C (40 °F)	Excellent
Screamin' Eagle Synthetic Blend Motorcycle Lubricant	SAE 20W50	HD 360	Above 4 °C (40 °F)	Good
Genuine H-D 360 Multi-grade	SAE 20W50	HD 360	Above 4 °C (40 °F)	Good
Multi-grade (oil certified for use in diesel engines)	SAE 10W40	SH, CH-4, CI-4, CJ-4	Below 4 °C (40 °F)	Excellent

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AIR CLEANER AND EXHAUST SYSTEM 1.7

AIR CLEANER REMOVAL

1. Open seat.
2. See Figure 1-7. On VRSCF models, remove the front side covers before proceeding.
3. See Figure 1-8. Remove air box cover by turning bailhead fastener 1/4 turn counterclockwise (CCW). Pull air box cover away from locating holes.

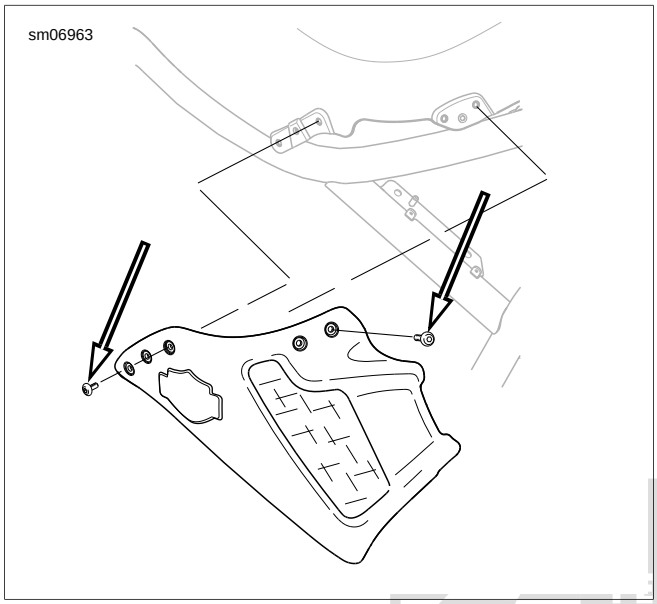
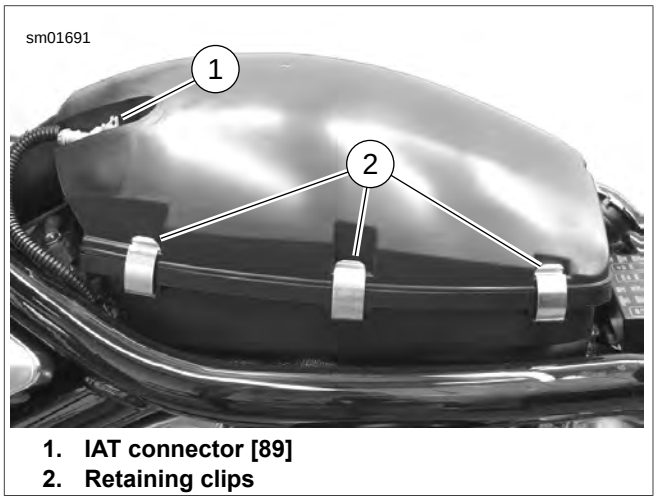


Figure 1-7. Front Side Cover Screws (VRSCF Model)



Figure 1-8. Air Box Cover Bailhead Fastener (typical)

4. See Figure 1-9. Remove IAT connector (1) by pushing down on bail wire to unlock. Air box top is retained by eight clips (2), three per side, one at the rear and one in the front under the snorkel. Disconnect clips and remove air box top.



1. IAT connector [89]
2. Retaining clips

Figure 1-9. Air Filter Top

5. See Figure 1-10. Remove wing nut securing filter cap and air filter.

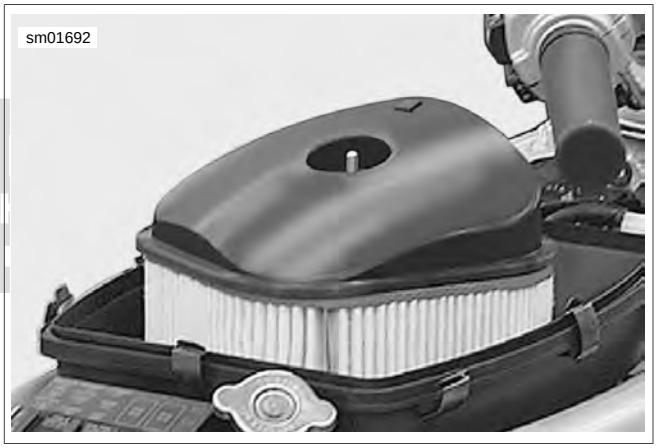
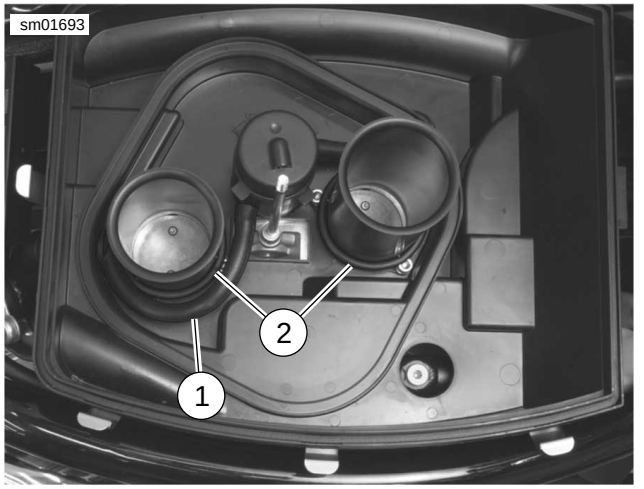


Figure 1-10. Air Filter

6. See Figure 1-11. Disconnect breather hose (1). Slide velocity stack O-ring (2) up the velocity stack body to access the three retaining fasteners. Remove the velocity stacks.



1. **Breather hose**
2. **O-rings**

Figure 1-11. Velocity Stacks (typical)

7. Gently lift the air filter bottom. Front breather hose is a press-fit and will disconnect, rear breather has a worm clamp holding hose to air filter bottom. Loosen clamp and remove air filter bottom.

NOTICE

Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

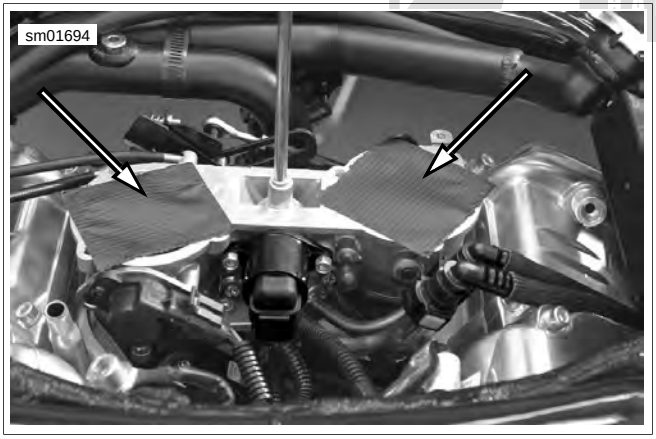


Figure 1-12. Air Box Removed (Throttle body bores shown by arrows)

INSTALLATION

FASTENER	TORQUE VALUE	
Velocity stack fasteners	6 Nm	53 **in-lbs**
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**

1. Remove tape from throttle body intakes.

2. See Figure 1-13. Inspect and replace bottom air box gasket if damaged. Check gasket position on air filter bottom. Gasket is located by three alignment pins on mating surface.

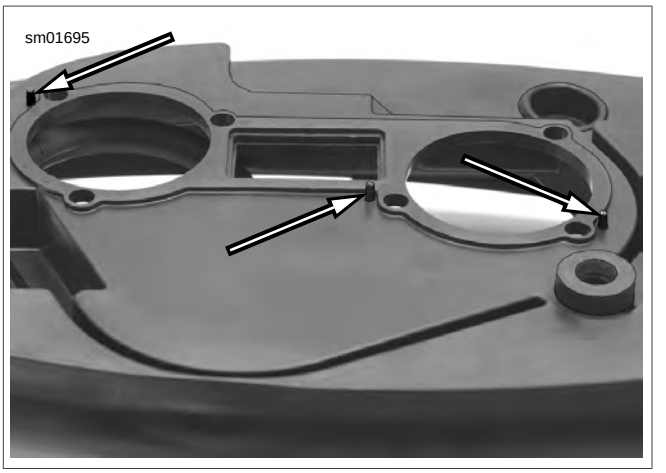


Figure 1-13. Air Filter Gasket Alignment Pins (3)

3. Place air filter bottom over throttle body and attach rear breather hose with hose clamp.

4. Align air filter bottom with front breather hose and press firmly in position.

NOTE

Velocity stacks have a mark at the bottom flange between two of the fastener locations. Align the mark with the corresponding mark on the air filter bottom.

LOCAL TECHNICIAN HARLEY-DAVIDSON



Figure 1-14. Velocity Stack Alignment Marks

5. Align index marks and install velocity stacks, longest in front. Tighten fasteners to 6 Nm (53 **in-lbs**).
6. Slide O-rings down the velocity stack body until they contact the three fasteners.

NOTE

The O-rings retain the velocity stack fasteners when assembling air box.

7. Attach the breather hose.
8. Place air filter element in air filter bottom.
9. Align air filter cap and fasten with wing nut. Turn wing nut 2.5-3 turns after contact.
10. Position air filter top over bottom section with snorkel between frame tubes at the steering neck.
11. Fasten clips along each side and clip at rear.

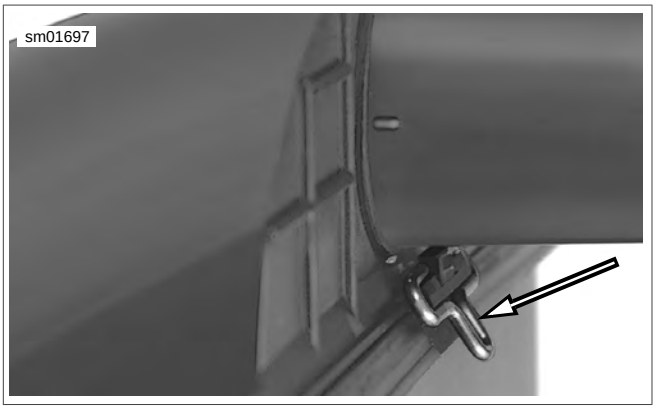
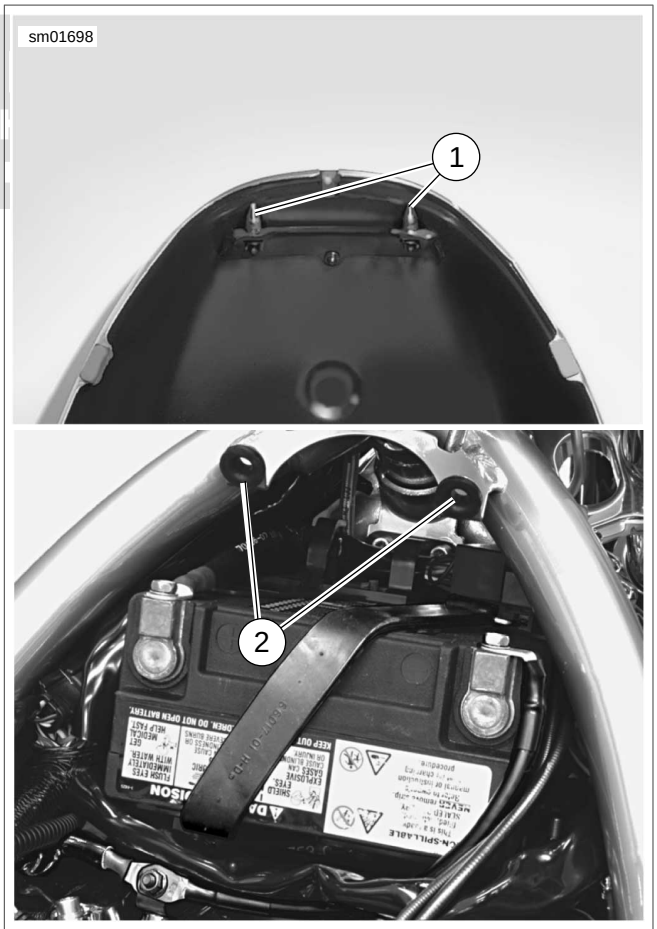


Figure 1-15. Front Air Box Clip

12. See Figure 1-15. Front clip under snorkel is attached to top section and must be fastened over the lip on the air filter bottom.
13. See Figure 1-9. Attach IAT connector.
14. See Figure 1-16. Position the air box cover with the locating pins (1) in the holes (2) on the frame tabs.
15. See Figure 1-8. Turn bailhead fastener 1/4 turn clockwise.
16. On VRSCF models, install side covers and tighten side cover fasteners to 4.1-6.8 Nm (36.3-60.2 **in-lbs**).



1. **Locating pins**
2. **Frame tab holes**

Figure 1-16. Air Box Cover and Frame Tabs (typical)

EXHAUST SYSTEM LEAK CHECK

Check the exhaust system for leaks at every scheduled service interval as follows:

1. Check entire exhaust system for loose or missing fasteners, damaged pipe clamps or brackets, and obvious signs of leakage (carbon tracks at pipe joints, etc.).
2. Check for loose or damaged heat shields. Repair or replace as necessary.
3. Start engine, cover muffler ends with clean, dry shop towels and listen for audible signs of exhaust leakage.
4. Correct any leaks detected. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF for exhaust system removal and installation procedures.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

TIRES AND WHEELS 1.8

TIRES

NOTE

ABS equipped motorcycles must always use tires and wheels that are the same as the original equipment. The ABS system monitors rotational speed of the wheels through individual wheel speed sensors to determine the application of ABS. Changing to different diameter wheels or different size tires can alter the rotational speed and upset the calibration of the ABS, resulting in an adverse effect on its ability to detect and prevent lockups. Operating with inflation pressure other than those specified in Table 1-8 can reduce ABS performance.

⚠WARNING

Match tires, tubes, rim strips or seals, air valves and caps to the correct wheel. Contact a Harley-Davidson dealer. Mismatching can lead to tire damage, allow tire slippage on the wheel or cause tire failure, which could result in death or serious injury. (00023c)

NOTES

- *Tubeless tires are used on all Harley-Davidson cast and disc wheels.*
- *Tire sizes are molded on the tire sidewall. Inner tube sizes are printed on the tube.*
- ***New** tires should be stored on a horizontal tire rack. Avoid stacking **new** tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.*

Check tire pressure and tread:

- As part of the pre-ride inspection.
- At every scheduled service interval.

1. Inspect each tire for punctures, cuts and breaks.
2. Inspect each tire for wear. Replace tires before they reach the tread wear indicator bars.

⚠WARNING

Be sure tires are properly inflated, balanced, undamaged, and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced, improperly inflated, overloaded or damaged tires can lead to tire failure and adversely affect stability and handling, which could result in death or serious injury. (00014b)

NOTE

Missing indicator wear bars represent less than 0.8 mm (1/32 in) tread pattern depth remaining.

3. Check for proper front and rear tire pressures when tires are cold. Compare results. Refer to Table 1-8.

NOTE

Harley-Davidson does not perform any testing with only nitrogen in tires. Harley-Davidson neither recommends nor discourages the use of pure nitrogen to inflate tires.

Table 1-8. Specified Tires

MOUNT	SIZE	SPECIFIED TIRE	PRESSURE (COLD)	
			PSI	kPa
Front	19 in.	Michelin Scorcher "11" 120/70ZR-19 60W	36	248
Rear	18 in.	Michelin Scorcher "11" 240/40R-18 79V	42	290

TIRE REPLACEMENT

Inspection

⚠WARNING

Use only Harley-Davidson specified tires. See a Harley-Davidson dealer. Using non-specified tires can adversely affect stability, handling or braking, which could result in death or serious injury. (00024b)

⚠WARNING

Replace tire immediately with a Harley-Davidson specified tire when wear bars become visible or only 1/32 in (0.8 mm) tread depth remains. Riding with a worn tire could result in death or serious injury. (00090c)

Harley-Davidson tires are equipped with wear bars that run horizontally across the tread. When a tire is worn to the point that the wear bars are visible, or 0.8 mm (1/32 in.) tread depth remains, the tire can:

- Be more easily damaged leading to tire failure.
- Provide reduced traction.
- Adversely affect stability and handling.

Arrows on tire sidewalls pinpoint location of wear bar indicators.

Tread wear indicator bars will appear on tire tread surfaces when 0.8 mm (1/32 in) or less of tire tread remains. Always replace tires before the tread wear indicator bars appear.

When To Replace Tires

New tires are needed if any of the following conditions exist:

1. Tread wear indicator bars become visible on the tread surfaces.
2. Tire cords or fabric become visible through cracked sidewalls, snags or deep cuts.

3. A bump, bulge or split in the tire.
4. Puncture, cut or other damage to the tire that cannot be repaired.

When installing tires on rims, do not rely on tread design to determine direction of rotation. Always be sure the rotational arrows molded into the sidewalls point in the direction of rotation when the vehicle is moving forward.

Refer to Table 1-8 for approved tires.

⚠WARNING

Use only Harley-Davidson specified tires. See a Harley-Davidson dealer. Using non-specified tires can adversely affect stability, handling or braking, which could result in death or serious injury. (00024b)

WHEEL BEARINGS

Service wheel bearings:

1. Replace when bearings exceed end play service wear limit of 0.051 mm (0.002 in.)
2. Inspect any time the wheels are removed.
 a. Inspect the play of the wheel bearings by finger while they are in the wheel.
 b. Rotate the inner bearing race and check for abnormal noise.
 c. Make sure bearing rotates smoothly.
3. Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only. See 2.27 SEALED WHEEL BEARINGS.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CLUTCH 1.9

GENERAL

The clutch is hydraulically actuated. The hand lever actuated master cylinder creates pressure in the clutch fluid line that activates a secondary clutch actuator mounted in the clutch release cover. The secondary clutch actuator piston extends and contacts a pushrod to disengage the clutch.

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

Do not wipe any spilled brake fluid off of finished surfaces. Always flush the affected components with clear (not soapy) water.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

FLUID INSPECTION

Check fluid level in clutch master cylinder reservoir.

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

1. Position vehicle on a flat, level surface. Turn handlebar so master cylinder is level.
2. See Figure 1-17. View reservoir sight glass and verify fluid presence. Sight glass should appear dark if fluid is present.

NOTE

Do NOT overfill clutch reservoir. Clutch fluid volume in reservoir increases with clutch wear and can damage seals causing damage to clutch system.

3. If sight glass is not dark:
 a. Check for fluid leaks in hydraulic clutch system.
 b. Remove reservoir cover and verify fluid level. If fluid level is below FILL LEVEL on ledge in reservoir, add HARLEY-DAVIDSON DOT 4 HYDRAULIC BRAKE FLUID. Do not exceed FILL LEVEL. Replace cover. See 2.16 BLEEDING CLUTCH FLUID LINE.

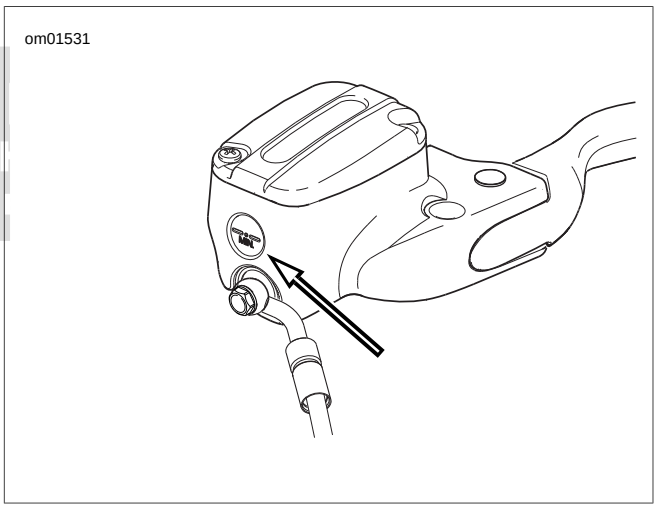


Figure 1-17. Clutch Reservoir Sight Glass

DRIVE BELT AND SPROCKETS 1.10

GENERAL

⚠WARNING

Never bend belt forward into a loop smaller than the drive sprocket diameter. Never bend belt into a reverse loop. Over bending can damage belt resulting in premature failure, which could cause loss of control and death or serious injury. (00339a)

In the case of stone damage to belt, inspect the sprockets for damage and replace as required. Always replace both transmission sprocket and rear sprocket during belt replacement.

CLEANING

Keep dirt, grease, oil, and debris off the drive belt and sprockets. Clean the belt with a rag slightly dampened with a light cleaning agent.

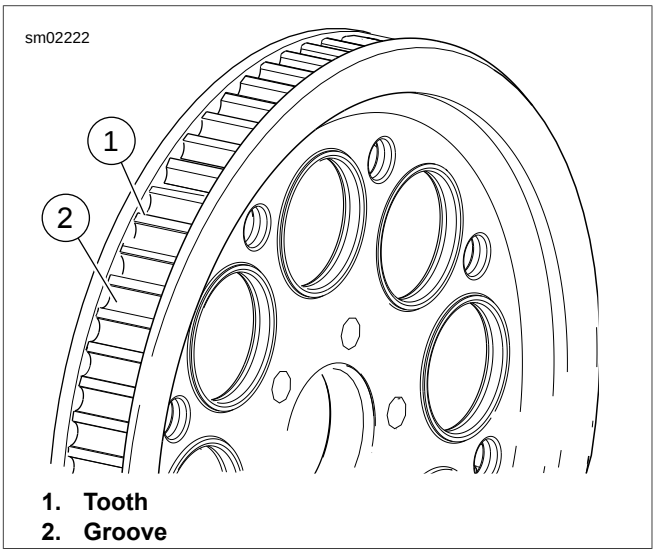
INSPECTION

Sprockets

NOTE

If chrome chips or gouges to rear sprocket are large enough to be harmful, they will leave a pattern on the belt face.

1. See Figure 1-18. Inspect each tooth (1) of rear sprocket for:
 a. Major tooth damage.
 b. Large chrome chips with sharp edges.
 c. Gouges caused by hard objects.
 d. Excessive loss of chrome plating (see next step).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
 a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
 b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.



1. **Tooth**
2. **Groove**

Figure 1-18. Rear Sprocket

Drive Belt

See Figure 1-19. Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn transmission sprocket teeth. Replace belt and transmission sprocket.
- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist.

NOTE

Condition 1 may develop into 2 or 3 over time. Condition 1 is not grounds for replacing the belt, but it should be watched closely before condition 2 develops which will require belt replacement.

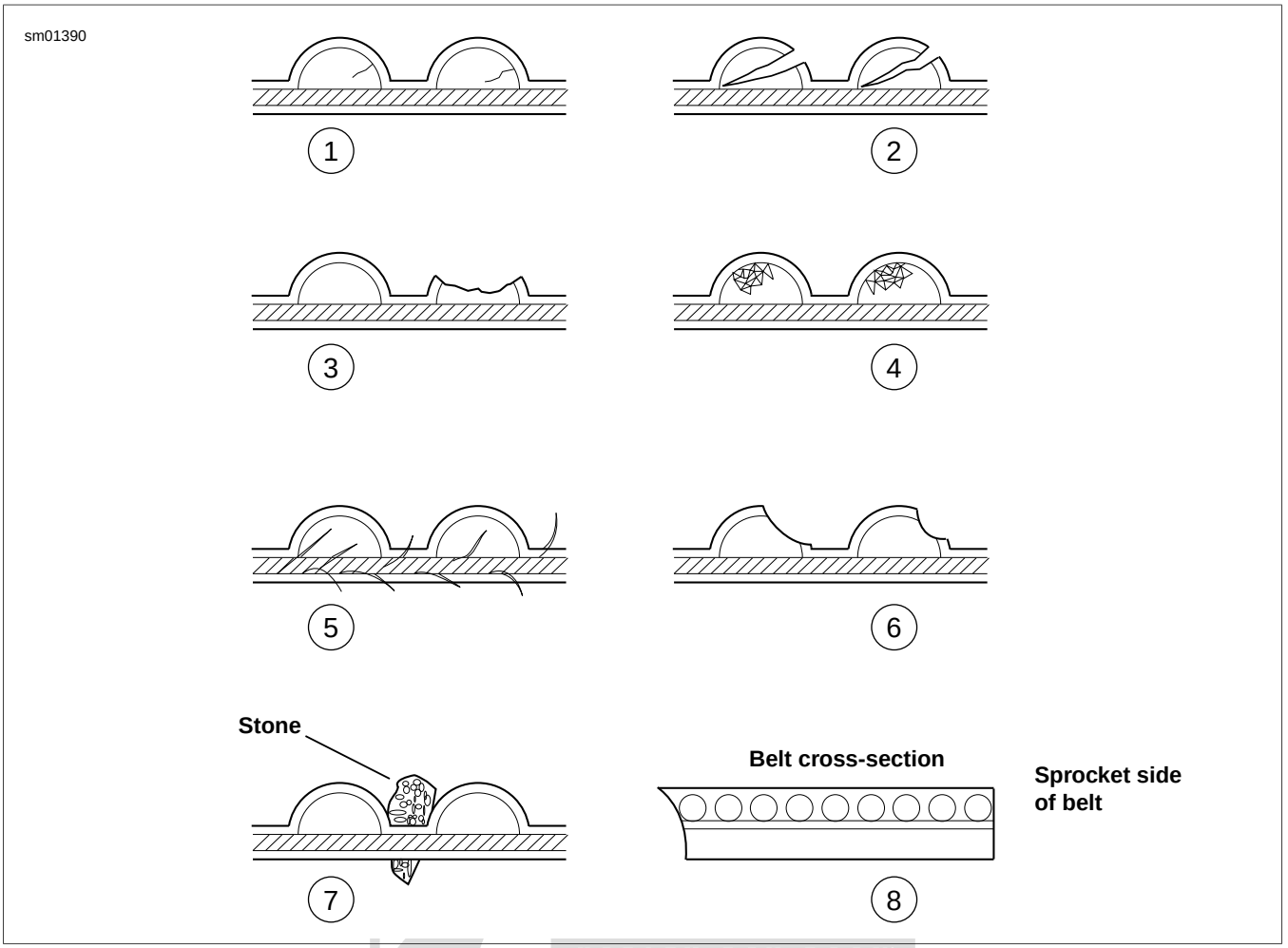


Figure 1-19. Drive Belt Wear Patterns

Table 1-9. Drive Belt Wear Analysis

PATTERN	CONDITION	REQUIRED ACTION
1	Internal tooth cracks (hairline)	OK to run, but monitor condition.
2	External tooth cracks	Replace belt.
3	Missing teeth	Replace belt.
4	Chipping (not serious)	OK to run, but monitor condition.
5	Fuzzy edge cord	OK to run, but monitor condition.
6	Hook wear	Replace belt and sprocket.
7	Stone damage	Replace belt if damage is on the edge.
8	Bevel wear (outboard edge only)	OK to run, but monitor condition.

CHECKING AND ADJUSTING DRIVE BELT DEFLECTION

PART NUMBER	TOOL NAME
HD-35381	BELT TENSION GAUGE

FASTENER	TORQUE VALUE	
Rear axle nut	190-203 Nm	140-150 ft-lbs

Check drive belt deflection:

- As part of the pre-ride inspection.
- At every scheduled service interval.

NOTES

- *Customers may purchase belt tension gauge from an authorized Harley-Davidson dealer.*
- *Setting tension without using BELT TENSION GAUGE typically results in loose belts. Loose belts will fail due to ratcheting (jumping a tooth) which causes tensile cord crimping and breakage.*

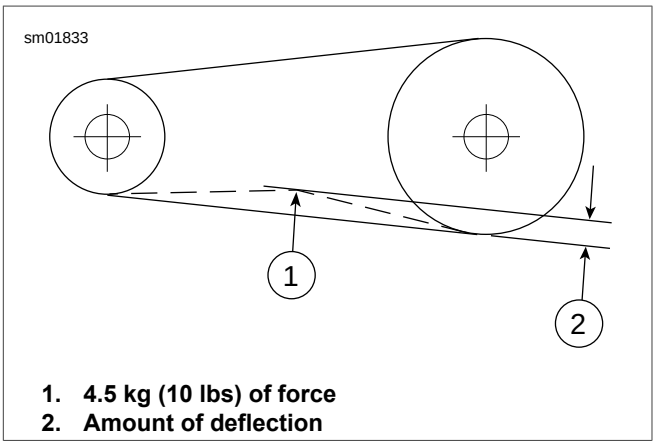
1. See Figure 1-20. Check drive belt tension with motorcycle cold, standing upright, transmission in NEUTRAL and no rider on motorcycle. Check belt tension at loosest point of belt.
2. See Figure 1-21. Using BELT TENSION GAUGE (Part No. HD-35381) apply 4.5 kg (10 lbs) of force upward.
3. Verify that the drive belt deflects 6-10 mm (0.23-0.39 in) for all models.

NOTE

Belt deflection window on the debris deflector is graduated in 2 mm increments.



Figure 1-20. Belt Tension Gauge (HD-35381)



1. 4.5 kg (10 lbs) of force
2. Amount of deflection

Figure 1-21. Checking Belt Deflection

4. See Figure 1-22. If belt adjustment is necessary, remove snap ring (1) and loosen axle nut (2) on right side of motorcycle.

NOTE

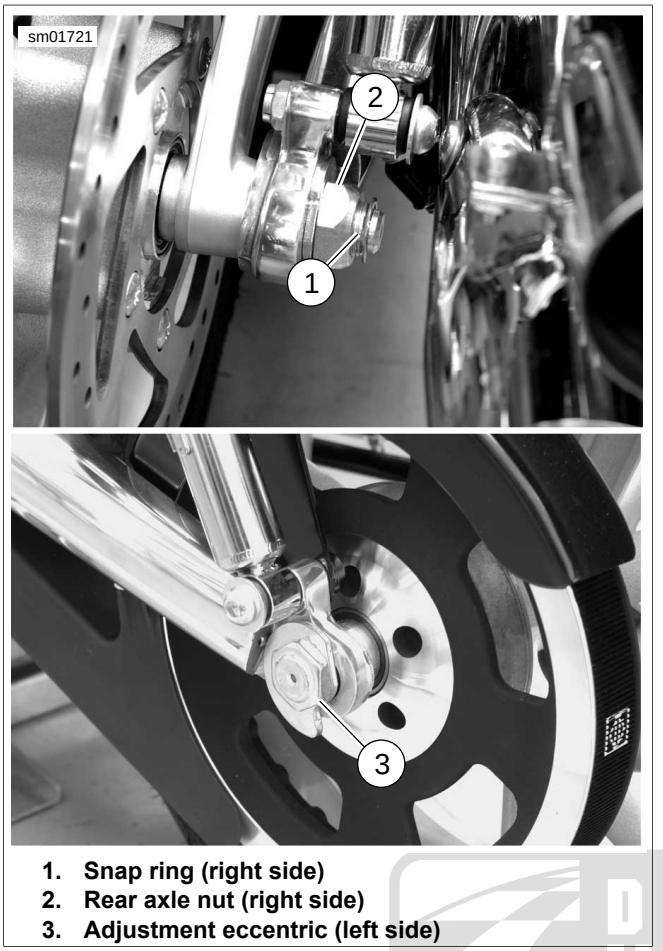
The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten belt. Counter-clockwise rotation will loosen belt.

5. Adjust belt tension by turning the axle adjustment eccentric on left side (3) until belt deflects 6-10 mm (0.23-0.39 in) with 4.5 kg (10 lbs) of force applied.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling and can cause loss of control, which could result in death or serious injury. (00285b)

6. Tighten rear axle nut (2).
 a. Tighten axle nut (2) to 190-203 Nm (140-150 ft-lbs).
 b. Install snap ring (1).



1. Snap ring (right side)
2. Rear axle nut (right side)
3. Adjustment eccentric (left side)

Figure 1-22. Axle Adjusters (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

THROTTLE CABLES 1.11

INSPECTION

WARNING

Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. (00494c)



Figure 1-23. Throttle Cable Routing

LUBRICATION

FASTENER	TORQUE VALUE	
Handlebar housing screws	4.0-5.1 Nm	35-45 **in-lbs**

1. See Figure 1-24. Turn the cable adjusters (2, 4) and jamnuts (3) as short as they will go.
2. Remove two screws (1) to separate the upper handlebar housing from the lower housing.
3. Use a screwdriver to rotate each ferrule and remove cable from the throttle grip.
4. Slide the throttle grip off the handlebar.
5. Apply a light coat of graphite to the handlebar and install throttle grip.
6. Put one or two drops of HARLEY LUBE into the housing of each cable.
7. Remove the air box cover and the air box and inspect cable routing. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
8. Install the air box and air box cover.
9. Assemble the handlebar housing and tighten both screws (1) to 4.0-5.1 Nm (35-45 **in-lbs**).

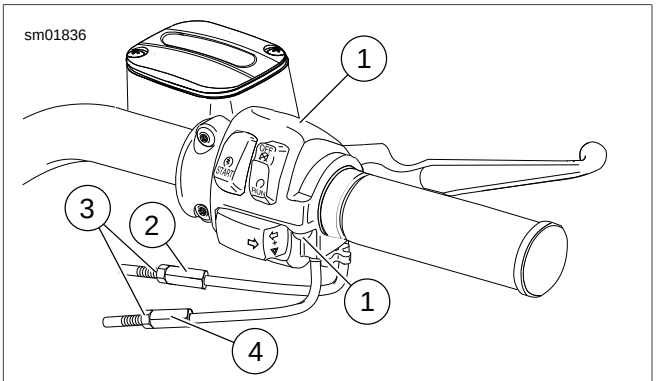
ADJUSTMENT

1. See Figure 1-24. Turn the cable adjusters (2, 4) and jamnuts (3) as short as they will go. Both cables should have zero adjustment at the start of this procedure.
2. Point the front wheel straight ahead.
 a. Rotate the throttle grip wide open and hold it there.
 b. Turn the throttle cable adjuster (2), lengthening the sleeve, until the throttle cam just touches the cam stop.
 c. Tighten the throttle cable adjuster (2) an additional 1/2-1 full turns.
3. Turn the front wheel full right.
4. Turn the idle cable adjuster (4), lengthening the sleeve until the cable housing just touches the bottom of the pocket retainer on the throttle body linkage.

WARNING

Pinched throttle cables can restrict throttle response, which could result in loss of control and death or serious injury. (00423b)

5. Check adjustment.
 a. Rotate the throttle grip and release to be sure the cable returns sharply to idle position. If the cable does not return to idle, turn idle cable adjuster (4), shortening the sleeve until correct adjustment is reached.
 b. Verify that the throttle operates without binding.
 c. Verify sufficient free play.
6. Tighten both jamnuts (3).



1. **Screws**
2. **Throttle cable adjuster**
3. **Jamnuts**
4. **Idle cable adjuster**

Figure 1-24. Throttle Cable Adjusters

CABLE, LINE AND FRAME INSPECTION 1.12

GENERAL

Inspect and lubricate the front brake lever, clutch hand lever, throttle control cables, and jiffy stand.

CABLES AND HAND LEVERS

Inspect and lubricate throttle cables. See 1.11 THROTTLE CABLES for throttle cables.

Use HARLEY LUBE for hand levers.

JIFFY STAND

Clean and lubricate the jiffy stand. See 2.41 JIFFY STAND.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals.

FUEL SYSTEM LINES AND FITTINGS

1. Inspect the fuel system lines.
2. Check the fuel system lines and fittings for leaks.
3. See Figure 1-25. Check fuel system lines for chafing against frame components.

HYDRAULIC LINES

1. Inspect hydraulic brake fluid lines and clutch fluid lines for leaks, contact or abrasion.
2. Check inside clear plastic tubing over braided lines for leakage inside tubing.



Figure 1-25. Fuel Lines (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FLUID INSPECTION

1. Position vehicle for inspection.
 a. **Front brake:** Position vehicle on a flat level surface. Turn handlebar so front brake master cylinder is approximately level. See Figure 1-26. View reservoir sight glass and verify fluid presence.
 b. **Rear brake:** Remove cooling system side cover fastener on underside of side cover. Swing out lower section and lift to unhook from top of assembly. Have an assistant hold vehicle upright on a level surface. See Figure 1-27 and Figure 1-28. View fluid level through sight window at rear of reservoir.
2. If fluid is not visible through sight glass (front brake) or fluid level in sight window is low (rear brake), check brake system for fluid leaks. Check that brake pads are properly installed and not worn beyond service wear limits. Perform any necessary repairs. See 1.14 BRAKE PADS AND DISCS.
3. If fluid is still not visible through sight glass (front brake) or fluid level in sight window is low (rear brake), remove cover and verify fluid level. If necessary, add DOT 4 BRAKE FLUID. Replace cover. See 2.21 BLEEDING BRAKES.
4. Front brake hand lever and rear brake foot pedal must have a firm feel when applied. If not, bleed system using only DOT 4 BRAKE FLUID. See 2.21 BLEEDING BRAKES.
5. **Rear brake:** Replace cooling system side cover, if removed.

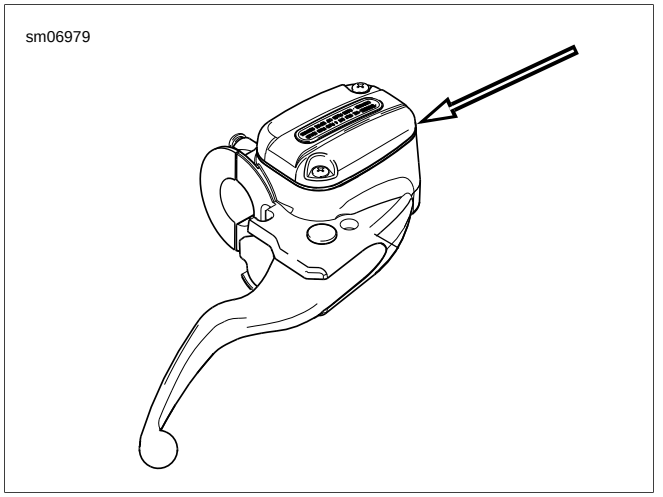


Figure 1-26. Front Master Cylinder Sight Glass (located on front of master cylinder)



Figure 1-27. Rear Brake Master Cylinder Reservoir (typical)

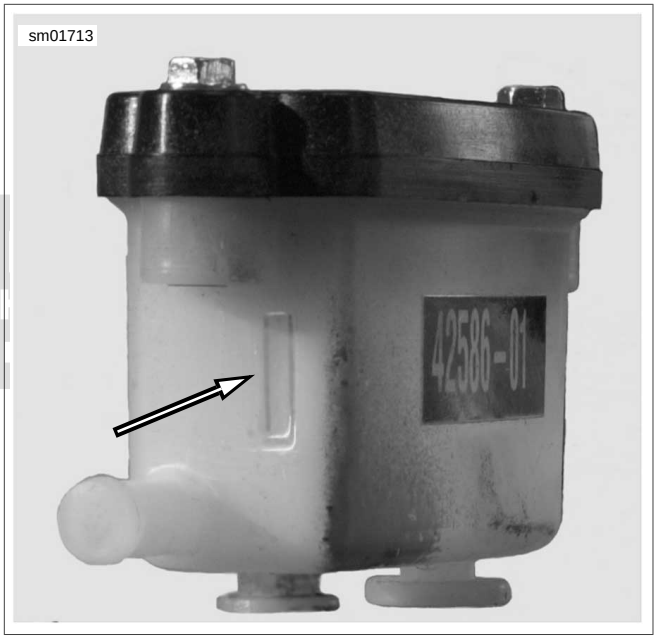


Figure 1-28. Rear Brake Fluid Reservoir Sight Glass (reservoir removed from motorcycle) (typical)

REAR BRAKE PEDAL

Pedal Adjustment

Rear brake pedal is non-adjustable.

BRAKE PADS AND DISCS 1.14

INSPECTION

Brake Pads

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

See Figure 1-31. Replace brake pads if brake pad friction material on either the front or rear caliper is worn to service limit (wear indicator lines no longer visible). Always replace both pads in a caliper as a set.

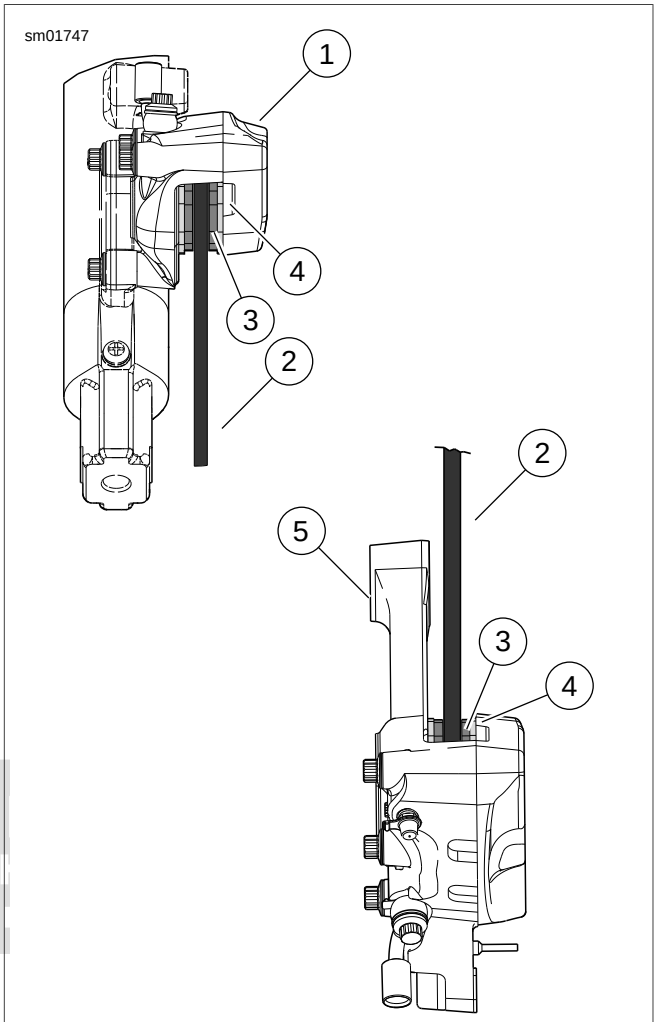
When checking the brake pads and discs, inspect the brake hoses for correct routing and any signs of damage.

Brake Disc Thickness

See Figure 1-29.The minimum brake disc (2) thickness is stamped on the side of the disc. Replace disc if badly scored.

Brake Disc Lateral Runout and Warpage

Maximum brake disc lateral runout and warpage is 0.3 mm (0.012 in.).



1. **Front brake caliper (viewed from below)**
2. **Brake disc**
3. **Brake pads**
4. **Backing plate**
5. **Rear brake caliper (viewed from above)**

Figure 1-29. Brake Pad Areas of Inspection (typical)

BRAKE PAD REPLACEMENT

FASTENER	TORQUE VALUE	
Caliper pad pin	8.5-11.5 Nm	75-102 **in-lbs**
Reservoir cap screws	0.7-0.9 Nm	6-8 **in-lbs**
Front caliper pin	8.5-11.5 Nm	75-102 **in-lbs**
Reservoir cap screws	1.1-1.4 Nm	10-12 **in-lbs**

Rear Brake Caliper

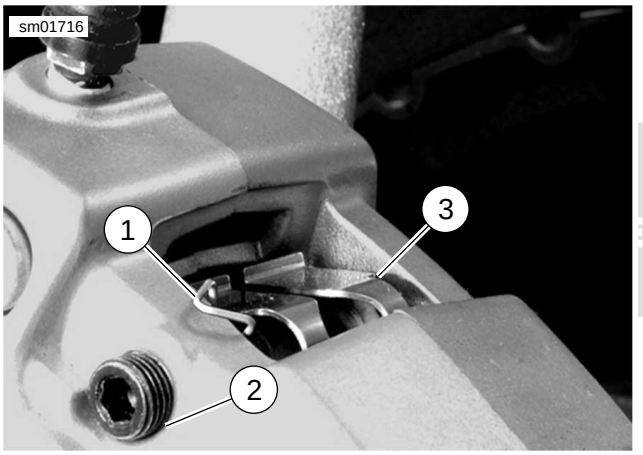
1. Remove right rear upper shock bolt and pivot shock absorber away to provide necessary clearance for performing rear brake service. See 2.36 REAR SHOCK ABSORBERS.

2. Remove rear master cylinder reservoir cap. As pistons are pushed back into the caliper, fluid level may rise more than available room. Fluid may need to be removed to allow for this.
3. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
4. See Figure 1-30. Remove screen cover by pulling single prong side first, caliper pin retainer clip, and caliper pin (6 pt/5 mm). Discard pad pin and pad pin clip.
5. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

NOTE

If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.

6. Inspect brake pad spring for wear or damage. Replace as necessary.



1. **Caliper pin retainer clip (always facing outward)**
2. **Caliper pin**
3. **Brake pad spring**

Figure 1-30. Rear Caliper Pad Clip and Pin (6 pt/ 5 mm) (caliper cover removed for photo clarity)

WARNING

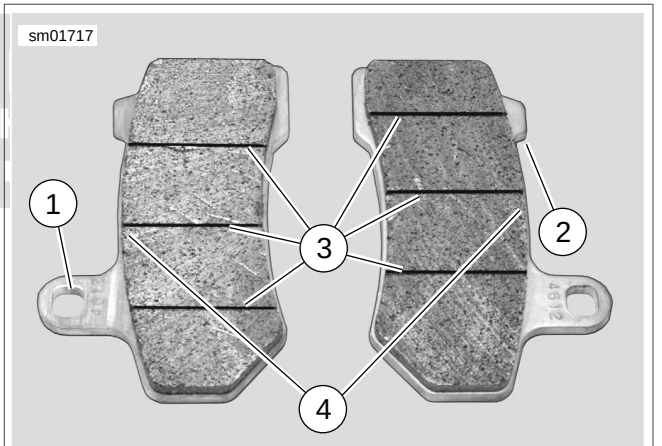
Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

7. See Figure 1-31. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.
8. Verify pads have been correctly installed and seated in caliper.
 a. Install **new** pad pin (provided in set) and tighten to 8.5-11.5 Nm (75-102 **in-lbs**).
 b. Install **new** caliper pin retaining clip (provided in set) with clip facing outward.
 c. Install two pronged side of screen cover on caliper first (two pronged side faces pin side of caliper), followed by snapping the single pronged side in.
9. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

10. Check brake fluid level in master cylinder. Push diaphragm in cover gasket in toward cover. Fill to proper level if necessary using DOT 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.7-0.9 Nm (6-8 **in-lbs**).



1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**
3. **Wear indicator lines**
4. **Curved portion**

Figure 1-31. Brake Pad Orientation

11. Install shock absorber. See 2.36 REAR SHOCK ABSORBERS.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

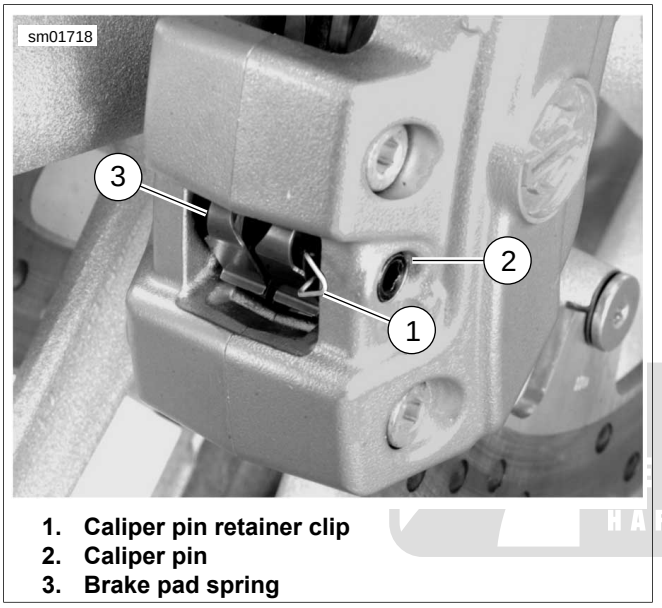
12. Test brake system.
 a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
 b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 2.21 BLEEDING BRAKES.

NOTE

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake disks.*

Front Brake Caliper

1. Remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than available room. Fluid may need to be removed to allow for this.



1. **Caliper pin retainer clip**
2. **Caliper pin**
3. **Brake pad spring**

Figure 1-32. Front Brake Caliper (Right Side Shown with screen cover removed)

2. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
3. See Figure 1-32. Remove screen cover by pulling single prong side first, then caliper pin retainer clip, and caliper pin (6 pt/5 mm). Discard pad pin and pad pin clip.
4. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

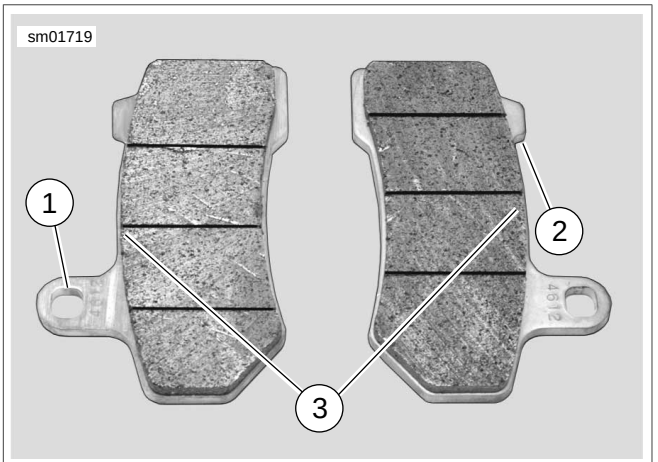
NOTE

If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.

5. Inspect brake pad spring for wear or damage and replace as necessary.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)



1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**
3. **Curved portion**

Figure 1-33. Brake Pad Orientation

6. See Figure 1-33. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.
 a. Install **new** caliper pin (provided in set) and tighten to 8.5-11.5 Nm (75-102 **in-lbs**)
 b. Install **new** caliper pin retainer clip (provided in set) with clip facing outwards.
7. Verify pads have been correctly installed and seated in caliper.
8. Install two pronged side of screen cover on pin side of caliper first, followed by snapping the single pronged side in.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

9. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.
10. Check brake fluid level in master cylinder. Fill to proper level if necessary using DOT 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 1.1-1.4 Nm (10-12 **in-lbs**).

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

11. Test brake system.
 a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 2.21 BLEEDING BRAKES.

NOTE

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake discs.*

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

SPARK PLUGS AND COIL 1.15

GENERAL

The spark plugs have been carefully selected for the performance characteristics of the VRSC engine. Use only **10R12A** spark plugs in the VRSC engine.

NOTE

Use only Harley-Davidson spark plugs made for the VRSC. Use of other spark plugs can affect the running characteristics of the engine and could result in engine damage.

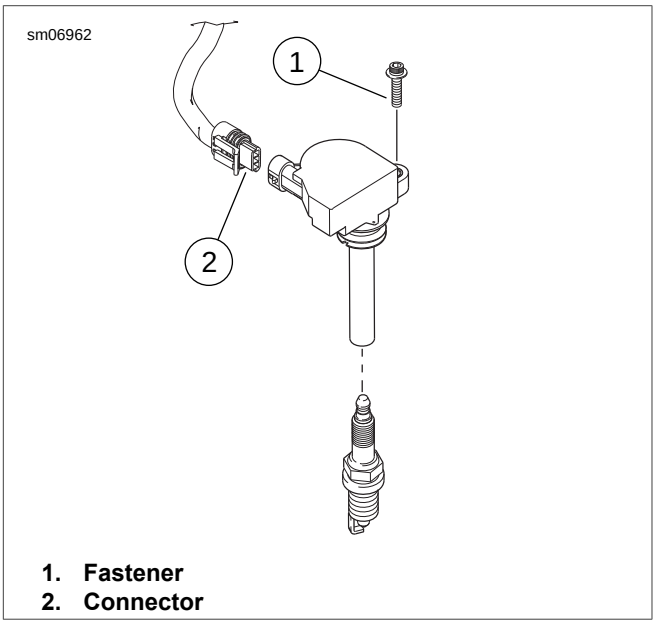
REMOVAL/INSPECTION

1. After the engine has cooled to room temperature remove air box assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
2. See Figure 1-34. Remove coolant overflow bottle by pulling bottle upward and rocking bottle free of mounting grommets and gain access to rear plug coil.



Figure 1-34. Coolant Bottle

3. See Figure 1-35. Remove rear coil fastener (1).
4. Detach connector (2) [83R] at rear coil, [83F] at front coil.
5. Pull coil and boot assembly straight up to disconnect spark plug.
6. Using a spark plug socket with plug retaining sleeve, remove rear spark plug.
7. Remove battery for access to front spark plug. See 1.24 BATTERY MAINTENANCE.
8. Remove front spark plug.



1. **Fastener**
2. **Connector**

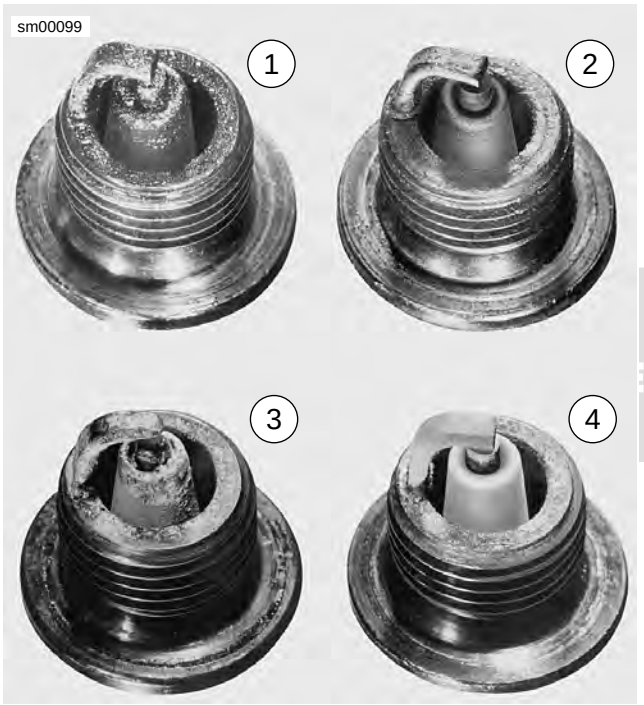
Figure 1-35. Plug Top Coil

9. See Figure 1-36. Compare your observations of the plug deposits with the descriptions provided.
 a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
 b. A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.
 c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.
 d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

10. If the plugs require cleaning between tune-ups, proceed as follows:
 a. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry plug with compressed air.
 b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.
 c. If the plugs cannot be cleaned, replace with No. **10R12A** spark plugs.
11. Check electrode gap with a wire-type feeler gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Proper gap measurement is 0.89 mm (0.035 in.).
12. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.



1. **Oil-fouled**
2. **Sooty black deposits**
3. **Overheated**
4. **Balanced combustion**

Figure 1-36. Typical Spark Plug Deposits

INSTALLATION

FASTENER	TORQUE VALUE	
Spark plugs	23 Nm	17 ft-lbs
Coil fasteners	9.7 Nm	86 **in-lbs**

1. Apply ANTI-SEIZE LUBRICANT to plug threads. Install and tighten to 23 Nm (17 ft-lbs).
2. Install coil and boot assembly over spark plug with wiring connector facing rear of motorcycle.
3. Insert coil fasteners with long fastener used on left side. Tighten to 9.7 Nm (86 **in-lbs**).
4. Mate connectors [83R] and [83F].
5. Install battery after installing front plug and coil. See 1.24 BATTERY MAINTENANCE.
6. Install rear plug and coil and install coolant overflow bottle.
7. Install air box assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

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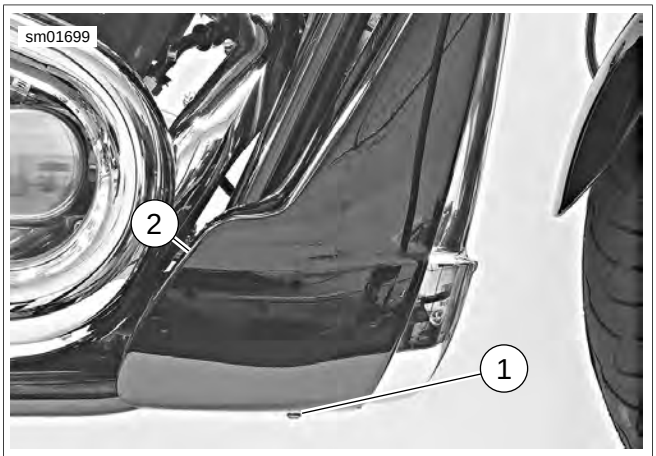
RADIATOR SIDE COVERS 1.16

REMOVAL

NOTE

The radiator side covers are delicate and should not be forced into or from mounted position. Use care during removal and installation to avoid damage.

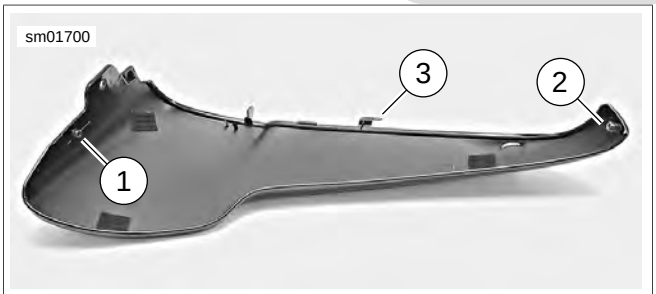
1. Remove main fuse.



1. **Lower radiator side cover fastener**
2. **Radiator side cover**

Figure 1-37. Lower Radiator Side Cover Fastener (typical) (mid mount control right side shown)

2. See Figure 1-37. Remove lower radiator side cover fastener.



1. **Bottom mounting pin**
2. **Top mounting pin**
3. **Latching tab**

Figure 1-38. Radiator Side Cover (typical) (inside view)

3. See Figure 1-38. Radiator side cover is held in place by a bottom mounting pin (1), top mounting pin (2) and latching tab (3). Remove radiator side covers as follows:
 a. See Figure 1-39. Grasp bottom of radiator side cover and pull down gently to disengage bottom mounting pin from bottom mounting hole located in radiator front cover.
 b. See Figure 1-40. While supporting radiator side cover, grasp top of side cover and pull up gently to disengage top mounting pin from mounting hole in front cover.
 c. Slide radiator side cover down gently to disengage latching tab from mounting lip in radiator front cover.
 d. Set radiator side cover aside.



Figure 1-39. Bottom Mounting Hole



Figure 1-40. Top Mounting Hole



Figure 1-41. Tab Mounting Lip

INSTALLATION

FASTENER	TORQUE VALUE	
Radiator side cover fastener	3-4 Nm	27-35 **in-lbs**

1. See Figure 1-38. Position radiator side cover on radiator front cover and gently slide side cover upward until latching tab fits into tab mounting lip.
2. See Figure 1-40. Engage top mounting pin of radiator side cover into top mounting hole of radiator front cover.
3. See Figure 1-39. Engage lower mounting pin of radiator side cover into bottom mounting hold of radiator front cover.
4. See Figure 1-37. Install radiator side cover fastener and tighten to 3-4 Nm (27-35 **in-lbs**).
5. Install main fuel.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

COOLING SYSTEM 1.17

CHECKING COOLANT LEVEL IN OVERFLOW BOTTLE

1. Remove air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

NOTICE

Use only Genuine Harley-Davidson Extended Life Anti-freeze and Coolant. Use of other coolants/mixtures may lead to engine damage. (00179b)

2. See Figure 1-42. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line on tank, remove cap from tank by using pull tab and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level reaches COLD FULL line.

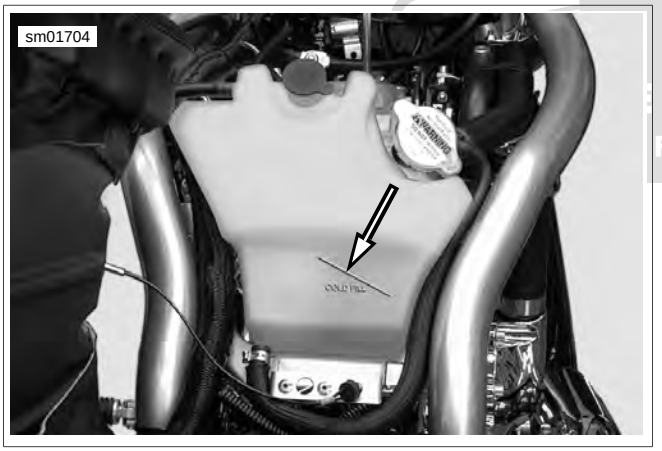


Figure 1-42. Cold Full Line On Overflow Bottle

CHECK FOR COOLANT IN SYSTEM

Coolant may be visible in the overflow bottle but not present in the rest of the cooling system.

1. Remove air filter top. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

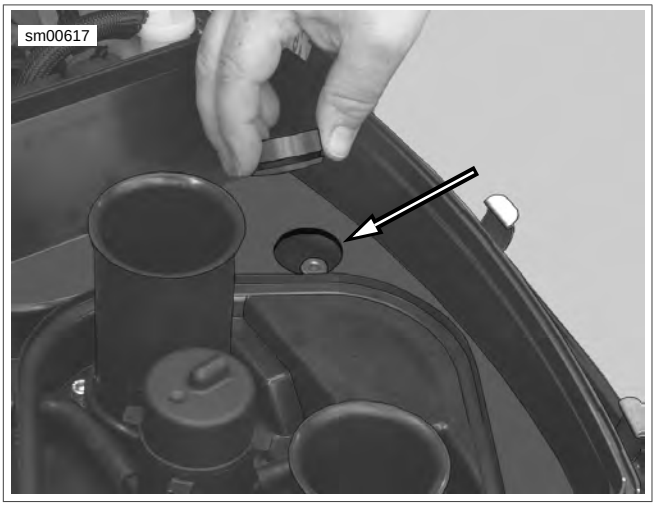


Figure 1-43. Air Bleed Plug

2. See Figure 1-43. Remove cooling system air bleed plug.
3. Gently squeeze vertical water pump coolant hose on right side of engine.
4. Verify coolant is visible in the air bleed hole. If coolant is not visible, see 5.4 ENGINE COOLANT.

SUSPENSION ADJUSTMENTS 1.18

SHOCK ABSORBERS

PART NUMBER	TOOL NAME
HD-94820-75A	REAR SHOCK SPANNER WRENCH

General

See Figure 1-44. Rear shock absorbers have five different preload settings. Use REAR SHOCK SPANNER WRENCH (Part No. HD-94820-75A) to adjust based on the weight the motorcycle is to carry. Preload settings change as the lower collar is turned (minimum preload setting 1, maximum preload setting 5).

Adjustment

⚠WARNING

Adjust both shock absorbers equally. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036b)

NOTICE

Do not turn the shock absorber adjustment collar clockwise beyond adjustment setting 5. Doing so may result in equipment damage. (00166b)

NOTES

- *Use the adjustment setting numbers as a reference for equal adjustment of shock absorbers on both the right and left side of the motorcycle.*
- *Typical preload position adjustment is setting 1 or 2 for the average rider. Use setting 3 for additional rider or load requirements.*
- *Adding a passenger or extra load may require maximum preload setting of 5. Be sure to adjust properly for loads to be carried.*

1. Place spanner wrench on the lower collar of the shock absorber and turn lower collar clockwise (toward higher numbers) to increase the preload or pressure.
2. Turn the lower collar counterclockwise to decrease the preload or pressure.

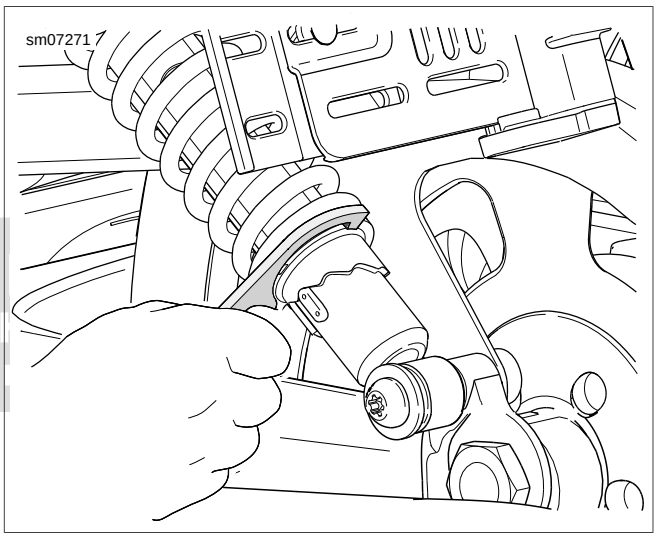


Figure 1-44. Rear Shock Adjustment

STEERING HEAD BEARINGS 1.19

ADJUSTMENT (FALL-AWAY)

FASTENER	TORQUE VALUE	
Steering stem bolt	9.5 Nm	84 **in-lbs**
Steering stem bolt	9.5 Nm	84 **in-lbs**
Fork and stem pinch bolts	41-48 Nm	30-35 ft-lbs
Fork stem bracket pinch bolts	41-48 Nm	30-35 ft-lbs

1. Support motorcycle in an upright position so the vehicle is level and the front wheel is raised.
2. Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front fork swings.

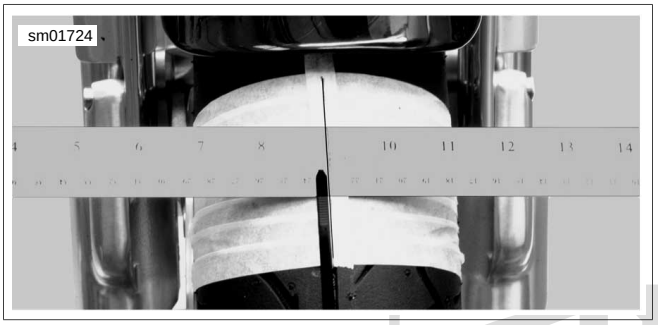


Figure 1-45. Fall-Away Measurement

3. See Figure 1-45. Install masking tape on front tire. Fasten ruler over taped area on front tire and draw a line on the masking tape even with the ruler center.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the ruler. The front fork should be straight ahead, however the balance point may be slightly off center.

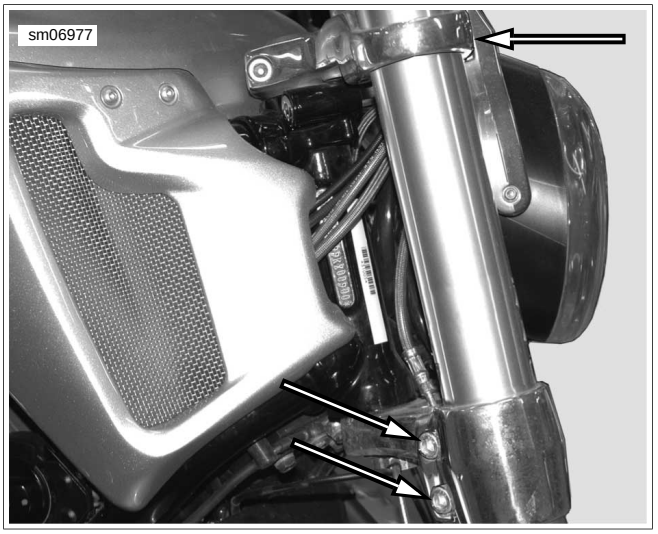
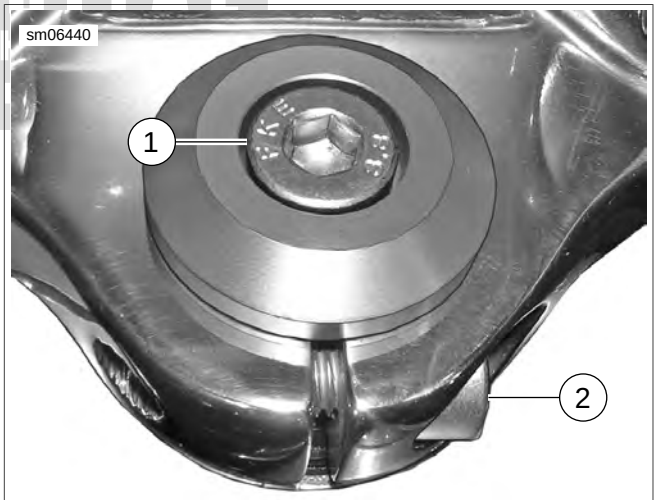


Figure 1-46. Pinch Bolts (VRSCF shown)

5. Check steering fall-away.
 a. Tap the tire on one side until the front fork begins to "fall-away." Record mark on ruler.
 b. Tap the tire on the opposite side until the front fork begins to "fall-away." Record mark on ruler.
 c. Measure distance between marks or subtract reading at one mark from reading at other.
6. See Figure 1-47. The distance between the "fall-away" marks must be 51-102 mm (2.0-4.0 in). Tighten or loosen steering stem bolt (1) per the following instructions.
 a. **VRSCDX/ANV:** Remove headlamp and mounting bracket to access upper fork clamp pinch bolts. See 7.13 HEADLAMP.
 b. Loosen steering stem pinch bolt (2) and upper fork clamp pinch bolts.
 c. If the distance is more 102 mm (4.0 in) loosen steering stem bolt. Tap upward on the upper fork clamp. Tighten steering stem bolt to a value less than 9.5 Nm (84 **in-lbs**).
 d. If it is less than 51 mm (2.0 in), tighten the steering stem bolt. Tap downward on the upper fork clamp. Tighten steering stem bolt to a value greater than 9.5 Nm (84 **in-lbs**).



1. **Steering stem bolt**
2. **Steering stem pinch bolt**

Figure 1-47. Steering Head Fork Stem Bolt and Pinch Bolt

NOTES

- *Tighten fork and stem pinch bolts to 41-48 Nm (30-35 ft-lbs) each time fall-away is checked.*
- *If adjustment seems to have no impact, check to see if fork tubes are stuck in clamps. If necessary, strike fork clamps with a dead blow hammer to free. Retest steering head bearing tension after freeing forks.*

7. Tighten fork stem bracket pinch bolts and stem pinch bolt to 41-48 Nm (30-35 ft-lbs).

8. **VRSCDX/ANV:** Install headlamp and mounting bracket. See 7.13 HEADLAMP.
9. Repeat the "fall-away" procedure to be sure the adjustment is correct.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

VALVE LASH 1.20

LASH MEASUREMENT

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-47181	ANGLE BLADE FEELER GAUGE SET

NOTE

Remove side covers from VRSCF models before proceeding.

⚠WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge fuel supply line of high pressure gasoline.
 a. Disconnect fuel pump and sensor connector [86B] from fuel pump/filter/sensor assembly.
 b. Start engine and allow vehicle to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove air box assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
4. Remove starter solenoid from battery box.
5. Remove all clipped connectors from battery caddy. Disconnect and remove starter solenoid.
6. Remove battery and tray components. See 1.24 BATTERY MAINTENANCE.

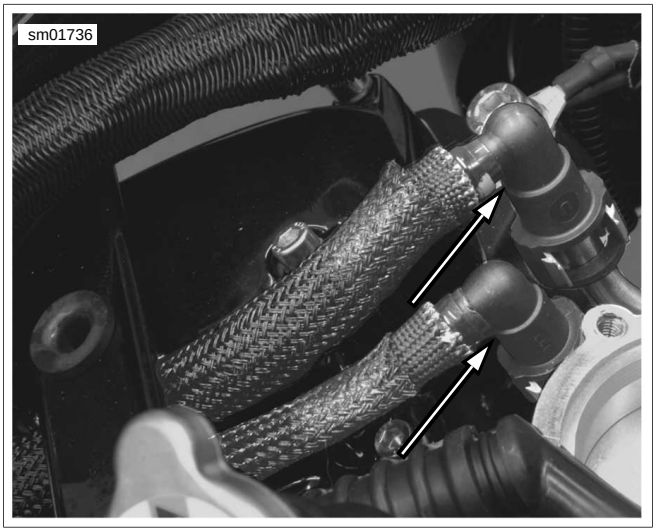
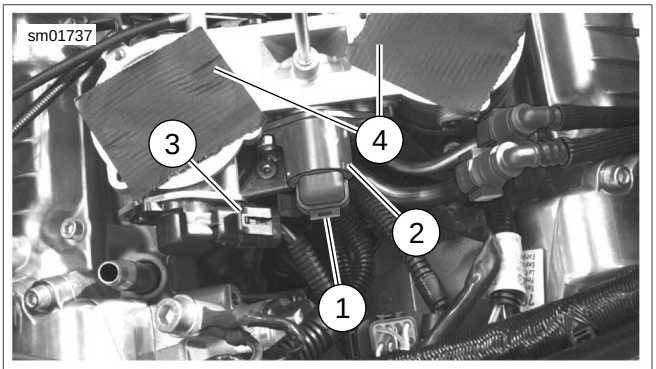


Figure 1-48. Fuel Line



1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Throttle position (TP) sensor connector [88B]**
4. **Injector intakes (covered)**

Figure 1-49. Throttle Body Electrical Connectors

7. See Figure 1-48. Remove fuel lines.
 a. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing release buttons with thumb and first finger.
 b. Remove fittings at the fuel tank.
 c. Pull fuel lines away from the throttle body.
 d. Remove ground wire from valve cover.
8. Remove front and rear coils. See 1.15 SPARK PLUGS AND COIL.
9. See Figure 1-49. Disconnect idle air control connector (1) from throttle body.
10. Disconnect throttle position (TP) sensor connector (3) from throttle body.

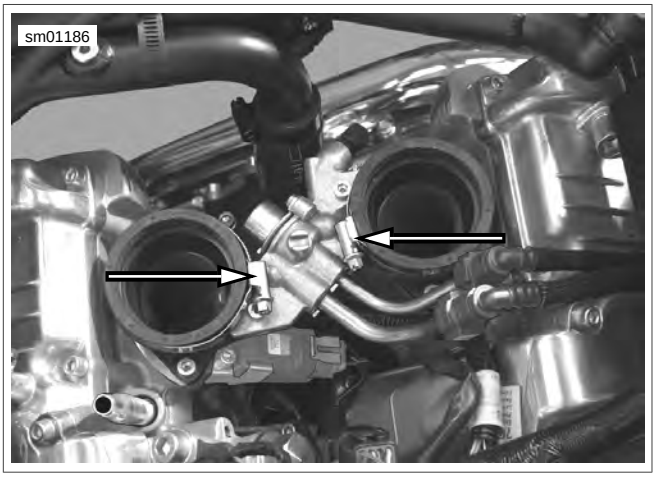
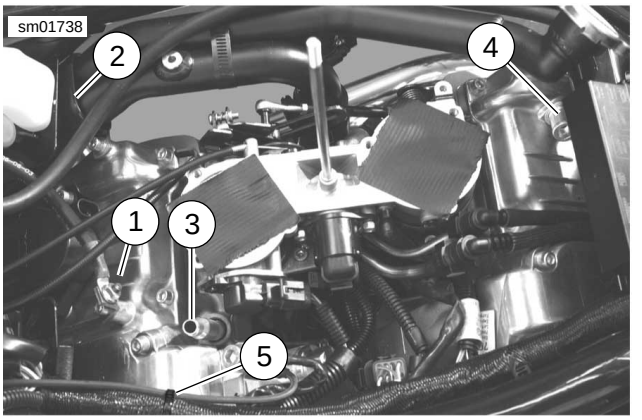


Figure 1-50. Intake Clamps, Throttle Body Removed (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. **Ground strap**
2. **Radiator hose P-clamp**
3. **Front cylinder breather tube**
4. **Rear cylinder breather tube**
5. **Cable strap**

Figure 1-51. Upper Engine

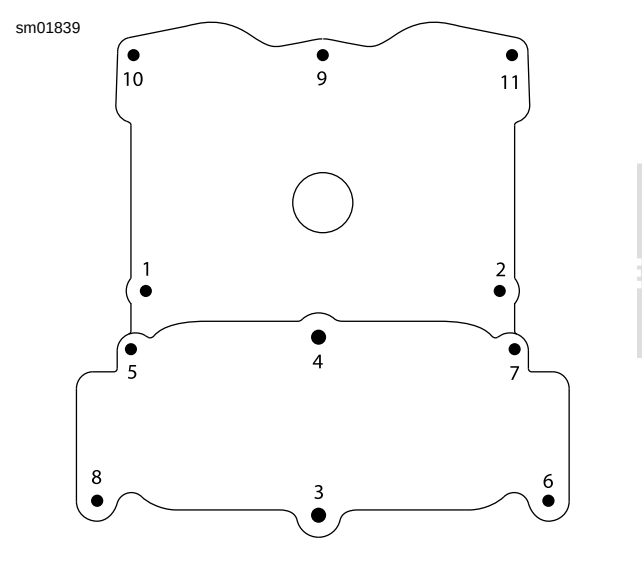


Figure 1-52. Cam Cover Torque Sequence

11. See Figure 1-50. Loosen clamps at each intake and lift throttle body straight up.

NOTE

Observe the position of the clamps for reassembly.

12. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
13. Cover intake openings to prevent objects from falling into intake bore.
14. See Figure 1-51. Remove ground strap at cam cover.
15. Remove P-clamp (2) retaining radiator hoses.
16. Remove front (3) and rear (4) breather hoses.
17. Remove main harness cable straps (5) along left side of frame.
18. See Figure 1-52. Loosen all cam cover fasteners in reverse order of torque sequence.
19. Support engine with jack under oil pan.
20. See Figure 1-53. Loosen front engine mount bolt and retract jack to allow the engine to drop down approximately 13 mm (1/2 in).

NOTE

Loosen drive belt and loosen exhaust at rear support bracket to allow the engine to drop sufficiently.

21. Remove fasteners from small cam cover and remove from left side.
22. Remove all remaining fasteners from cam cover.
23. Gently pry up cover and gasket. Remove cam cover by lifting up and over cam drive sprockets and removing from right side of motorcycle.

NOTES

- *For additional clearance, move radiator hoses to allow front cam cover removal.*
- *For additional clearance, remove breather hose fitting from rear cam cover to gain additional clearance.*
- *For additional clearance, remove rear oil pan fasteners and rotate engine downward.*

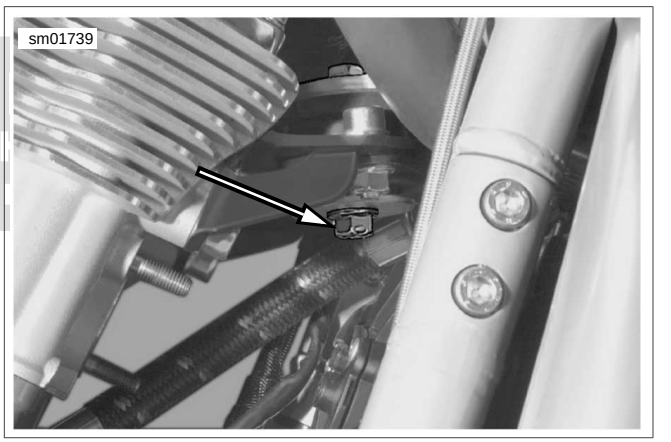


Figure 1-53. Front Engine Mount Bolt

24. Remove spark plugs. See 1.15 SPARK PLUGS AND COIL.

NOTE

Spark plugs are only removed to allow the crankshaft to rotate easily. Spark plugs should be installed and tightened to specification immediately after lash is set and before assembly begins.

25. Remove alternator clutch cover to access rotor nut.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

26. See Figure 1-54. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the crankshaft in the direction of normal operation until nose of camshaft

intake and exhaust are at the 2 o'clock and 10 o'clock position.

a. See Figure 1-55. When adjusting the front cylinder the tappets will be at the base circle position with the lobes as shown.

b. See Figure 1-56. When adjusting the rear cylinder the tappets will be at the base circle position with the lobes as shown.

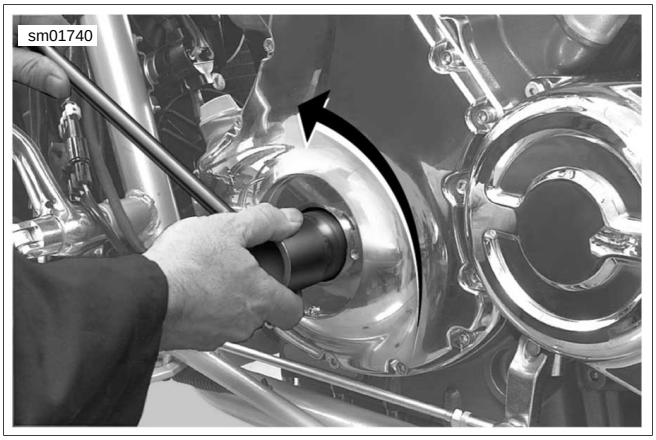


Figure 1-54. Correct Crankshaft Rotation

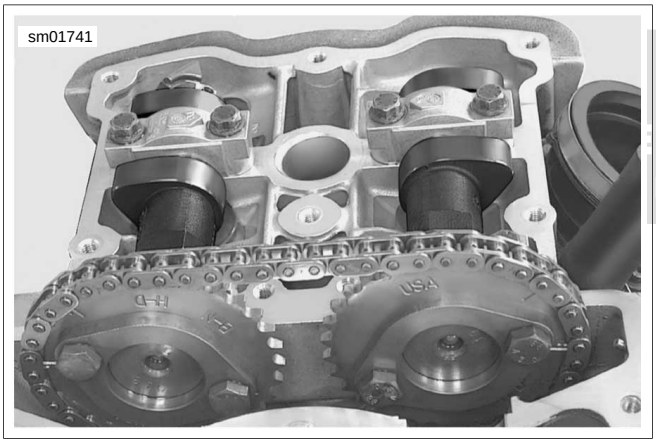


Figure 1-55. Front Cylinder Cam Lobe Position

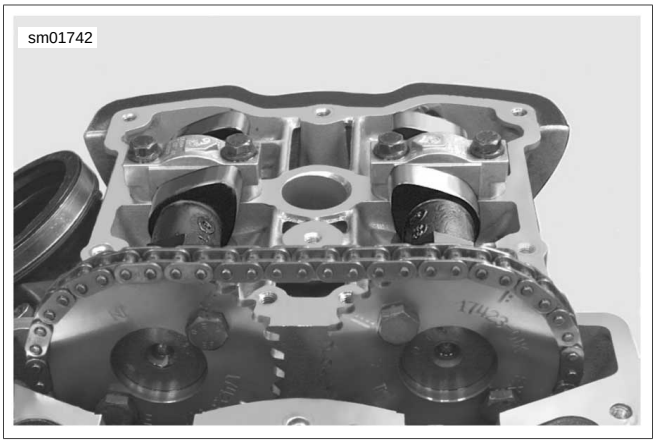


Figure 1-56. Rear Cylinder Cam Lobe Position

27. See Figure 1-57. Use blade style metric feeler gauges to measure the gap (lash) between the cam and tappet.

NOTE

Use ANGLE BLADE FEELER GAUGE SET (Part No. HD-47181) to more easily measure valve lash.

Table 1-10. Valve Lash Specifications

		MM	IN.
Intake	Max	0.245	0.0096
	Min	0.195	0.0078
Exhaust	Max	0.345	0.0135
	Min	0.295	0.0117

28. Measure and record the lash of one cylinder head.

29. Compare measurements to Table 1-10.

30. Repeat valve lash measurements on other cylinder head and record initial lash measurements.

NOTE

If cam journal caps are removed, install and finger-tighten before applying torque.

31. If all valves are within specification, verify cam timing before reassembly. See 1.20 VALVE LASH, Verify Cam Timing.

32. If cam timing is correct, install spark plugs, install cam covers and front engine mount.

33. If valve lash must be adjusted, verify cam timing before disassembly. See 1.20 VALVE LASH, Verify Cam Timing.

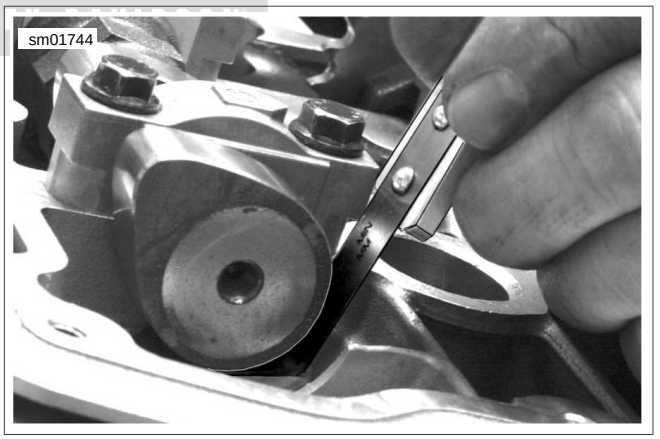


Figure 1-57. Measuring Valve Lash

CAMSHAFT INSPECTION

Anytime the camshafts are visible, the lobes should be inspected for damage.

NOTE

It is not necessary to remove camshafts for this inspection. Camshafts are removed for photo-clarity.

Lobe Surface Finish

There are two styles of surface finish found on VRSC camshafts. The first is called camground which can be seen in Figure 1-58. This lobe appears very smooth. The second finish

is called micro-stoned which can be seen in Figure 1-59. This lobe will have horizontal finish marks on the lobes from the finishing stone used in the manufacturing process. Both are acceptable finishes on VRSC camshaft lobes.



Figure 1-58. Camground Camshaft Lobes

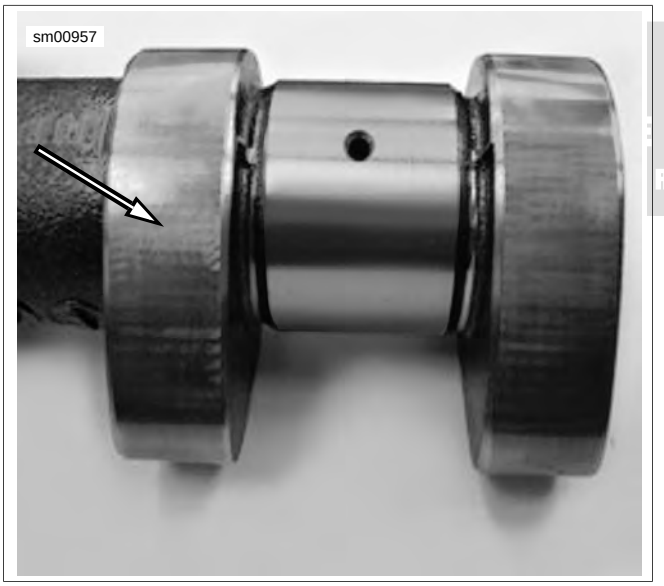


Figure 1-59. Micro-Stoned Camshaft Lobes

Camshaft Spalling

Camshaft spalling can occur on either the heal, toe or ramp of the camshaft lobe. If within the following guidelines, the spalling is considered within specification.

- See Figure 1-60. This figure shows camshaft spalling within acceptable specification on the toe of the camshaft lobe.
- See Figure 1-61 and Figure 1-62. If camshaft lobe exhibits spalling that extends fully across the width of the camshaft lobe or extends past 15 mm (0.59 in.) beyond the toe of the camshaft lobe in either direction of camshaft travel, replace camshaft.
- Any spalling on the camshaft heel (base circle) is unacceptable.

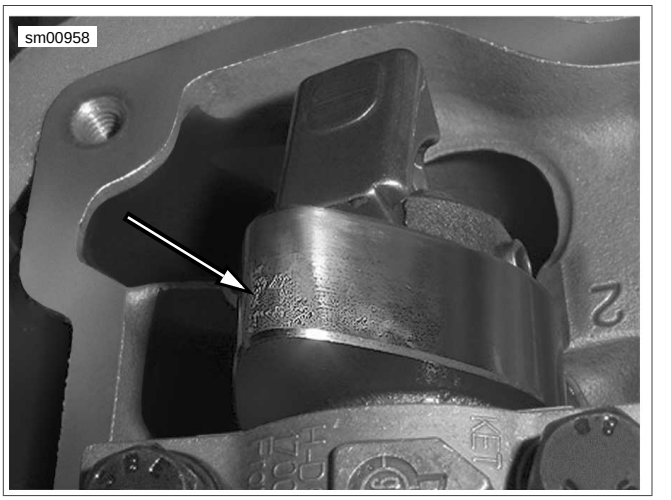


Figure 1-60. Camshaft Toe Spalling (acceptable)

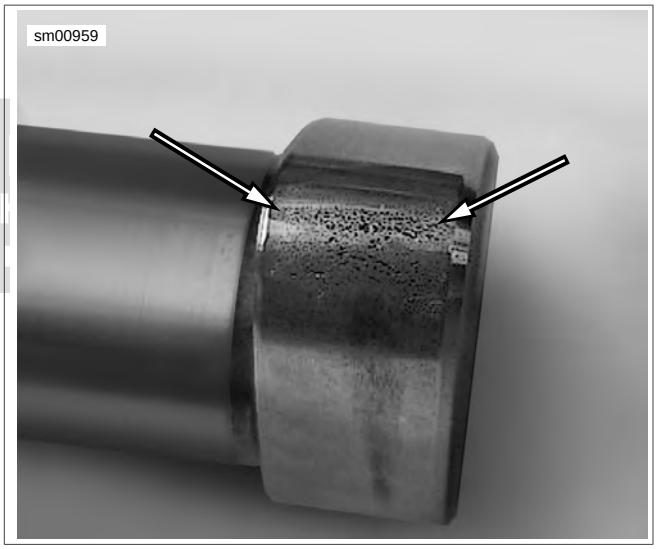


Figure 1-61. Camshaft Toe Spalling (unacceptable)

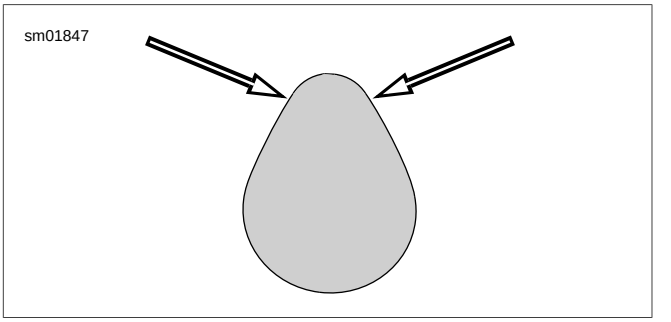


Figure 1-62. Maximum Spalling Area

VERIFY CAM TIMING

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45653	TDC POSITIONING TOOL

1. See Figure 1-63. Install TDC POSITIONING TOOL (Part No. HD-45653) in front spark plug hole.

NOTE

Never insert a foreign object such as a screwdriver in the spark plug hole. Engine damage can result.

2. Remove derby cover.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

3. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the crankshaft direction of normal operation and observe exhaust cam lobe. Note when exhaust valve is closing (TDC Tool will start to extend as valve closes) and crankshaft is approaching TDC.
4. Verify that the TDC POSITIONING TOOL is fully extended and front piston is at TDC.
5. See Figure 1-64. Note position of cam sprocket gear marks and cam lobe positions. At front cylinder TDC, timing is correct when:
 a. The front exhaust and intake cam gear marks (2, 3) are aligned.
 b. The front exhaust and intake cam lobes (6, 7) are positioned as illustrated.
 c. The rear intake and exhaust cam gear marks (4, 5) are aligned.
 d. The rear intake and exhaust cam lobes (8, 9) are positioned as illustrated.

NOTE

Copper colored links (1) are only used in installation of cam chains. They may not appear in the positions illustrated.

6. Install derby cover.

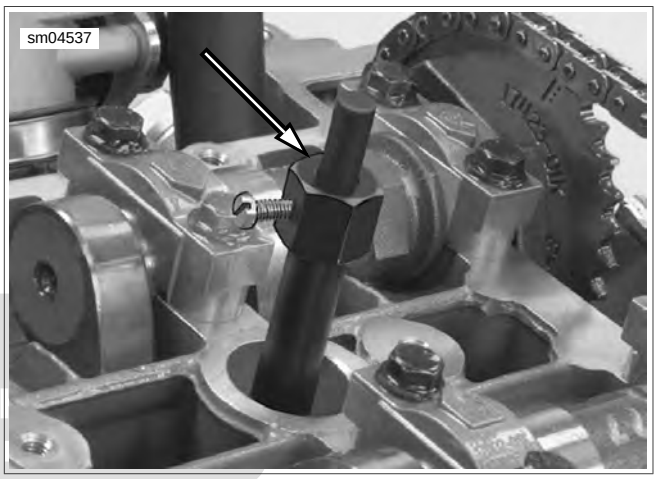
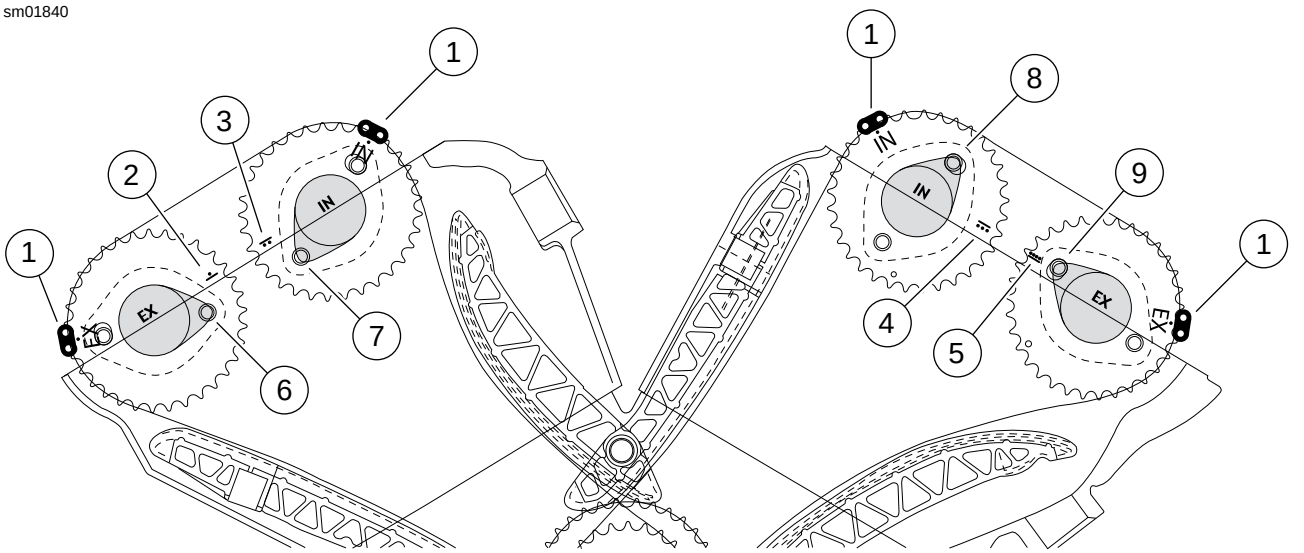


Figure 1-63. Top Dead Center Positioning Tool



1. **Copper links (may not appear where illustrated)**
2. **Front exhaust alignment mark (single dot and line)**
3. **Front intake alignment mark (two dots and line)**
4. **Rear intake alignment mark (three dots and line)**
5. **Rear exhaust alignment mark (four dots and line)**
6. **Front exhaust cam lobe position**
7. **Front intake cam lobe position**
8. **Rear intake cam lobe position**
9. **Rear exhaust cam lobe position**

Figure 1-64. TDC Cam Timing Orientation

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

LASH ADJUSTMENT

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45340	GASKET ALIGNMENT DOWELS

FASTENER	TORQUE VALUE	
Cam journal caps	9.7 Nm	86 **in-lbs**
Spark plugs	23 Nm	17 ft-lbs
Cam cover fasteners	11 Nm	97 **in-lbs**
Front engine mount fastener	38 Nm	28 ft-lbs
Radiator hose fasteners	9.7 Nm	86 **in-lbs**
Cam cover fasteners	9.7 Nm	86 **in-lbs**

1. See Figure 1-65. Usie CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) to rotate the crankshaft in the direction of normal operation to position front cylinder cam lobes at 10 o'clock and 2 o'clock.
2. See Figure 1-66. Clean oil from cam drive gear and chain link. Make a reference mark on chain and cam drive gear, both intake and exhaust, as shown.

NOTE

Copper colored links are for initial assembly of complete cam drive system.

3. See Figure 1-67. Remove secondary cam chain tensioner.

NOTES

- *NEVER rotate crankshaft with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.*
- *Do not remove cam drive gear bolts. It is not necessary for the lash adjustment.*

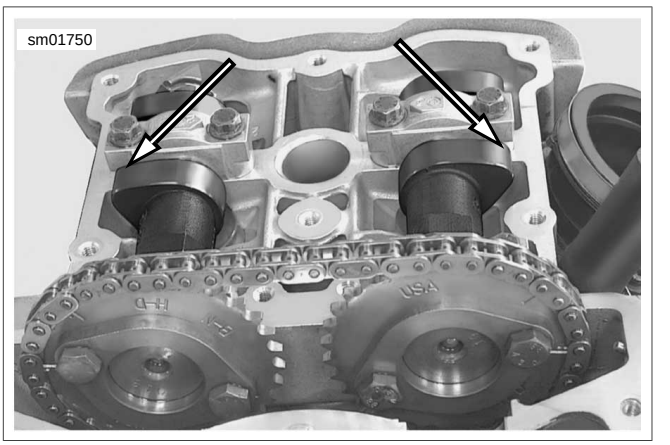


Figure 1-65. Front Cylinder 10 and 2 O'clock Cam Lobe Position

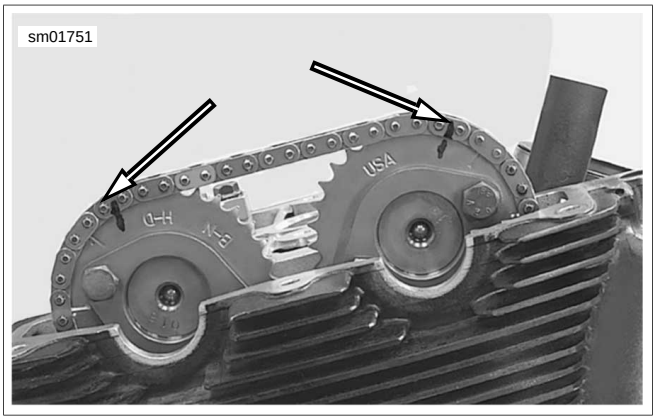


Figure 1-66. Reference Mark Cam Gear and Chain Link

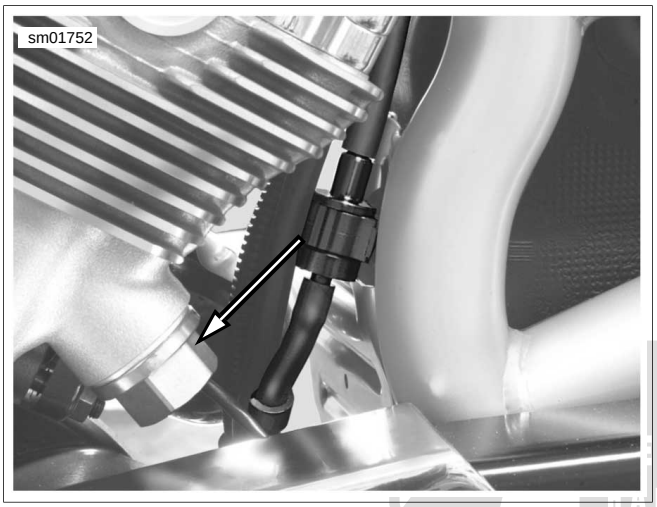


Figure 1-67. Secondary Cam Chain Tensioner

4. See Figure 1-68. Remove cam journal fasteners and caps from the cam needing adjustment.

NOTE

Remove and adjust only one camshaft at a time.

5. See Figure 1-69. Carefully move cam and drive gear aside. Keep cam drive gear and chain engaged.

NOTE

Handle chain and cam assembly carefully so as not to remove reference marks.

6. Carefully remove tappet using a strong magnet to help will keep shim and tappet together during removal. Oil film will usually cause shim to adhere to the under side of the tappet. Take care that shim does not dislodge and fall into engine.

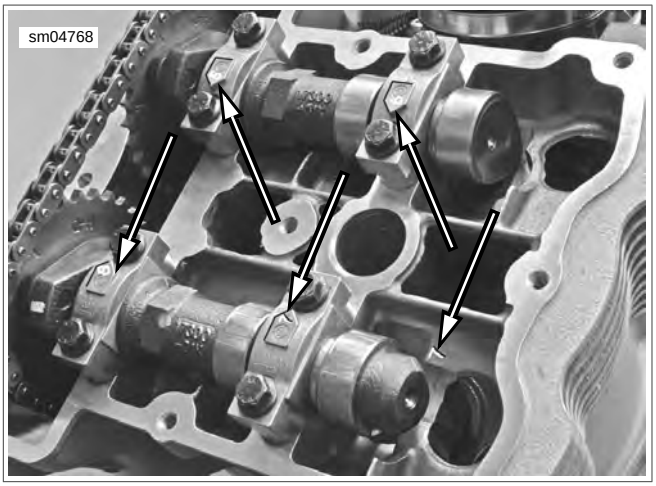


Figure 1-68. Cam Journal Caps

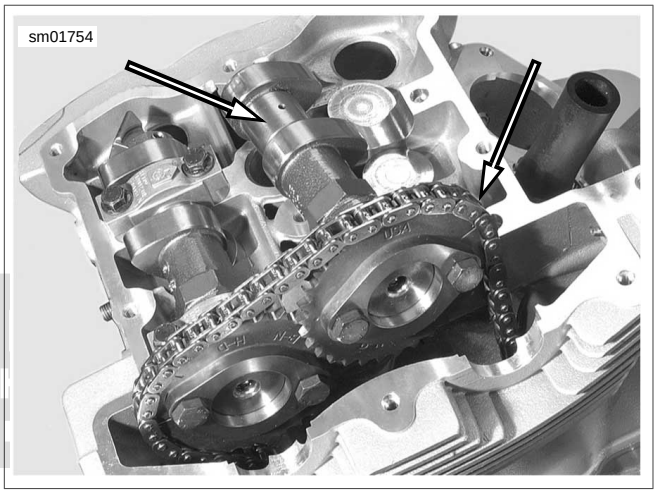


Figure 1-69. Move Cam Aside With Chain Engaged

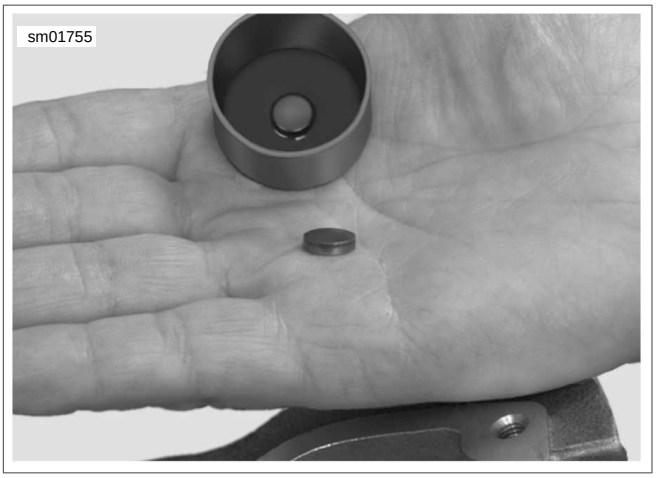
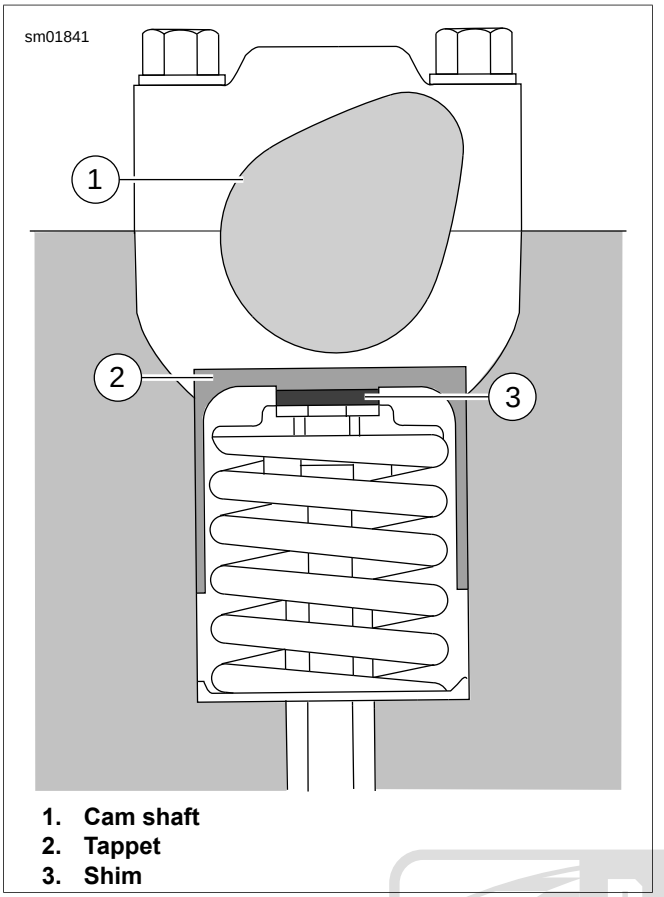


Figure 1-70. Tappet And Shim



1. **Cam shaft**
2. **Tappet**
3. **Shim**

Figure 1-71. Cam, Tappet, Shim Orientation

7. See Figure 1-72. Use a micrometer to measure the thickness of the removed shim. Record measurement in the "Installed Shim Measurement" column on valve lash calculation worksheet. See D.3 VALVE LASH CALCULATION WORKSHEET 2.

NOTE

Only use genuine Harley-Davidson shims for adjusting valve lash. Do not use typical shim stock. Shim stock can dislodge and cause severe engine damage.

8. Calculate and record on the valve lash calculation worksheet the "New Shim Lower Limit" and the "New Shim Upper Limit."
9. Calculate and record "Desired Shim Size."
10. Select and record the "Closest Shim Size" replacement shim. Refer to D.1 VALVE TAPPET SHIMS and D.2 VALVE LASH CALCULATION WORKSHEET 1.
11. See Figure 1-72. Always confirm **new** shim thickness with micrometer. Record for reference.
12. See Figure 1-73. Orient **new** shim in spring retainer pocket. Use a magnet to position the shim and carefully push into place with finger.
13. Install tappet.
14. If the initial lash measurement of the remaining valve exceeds the upper or lower valve lash limits, perform the lash adjustment on the remaining valve.
15. See Figure 1-66. Install cam in alignment with reference marks made during disassembly.
16. See Figure 1-74. Cam journal caps are numbered. Install cam journal caps with corresponding number on head and arrow pointing to center of head. Lubricate cam journal and journal cap with oil before placing in position.
17. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
18. Repeat procedure with remaining cam if necessary.

NOTE

NEVER rotate crankshaft with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

19. After completing adjustments, install secondary cam chain tensioner.



Figure 1-72. Measure Shim

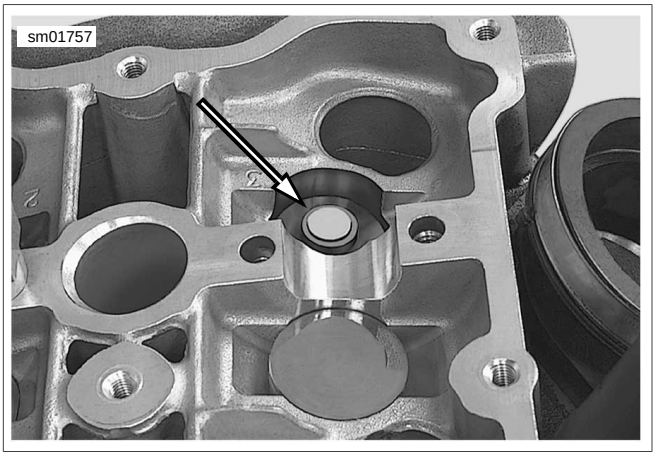


Figure 1-73. Position Shim

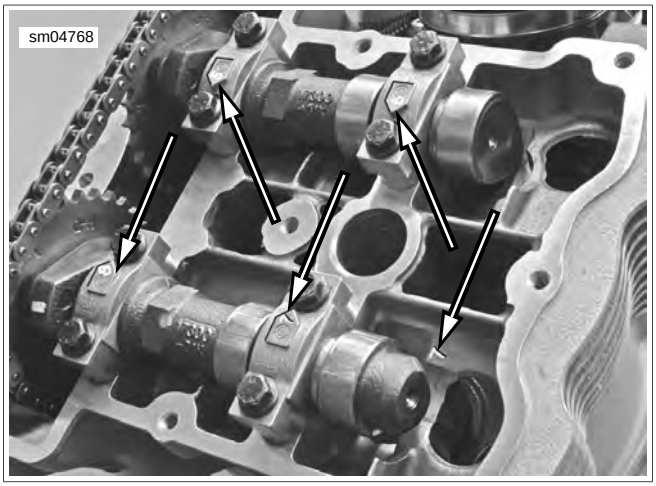


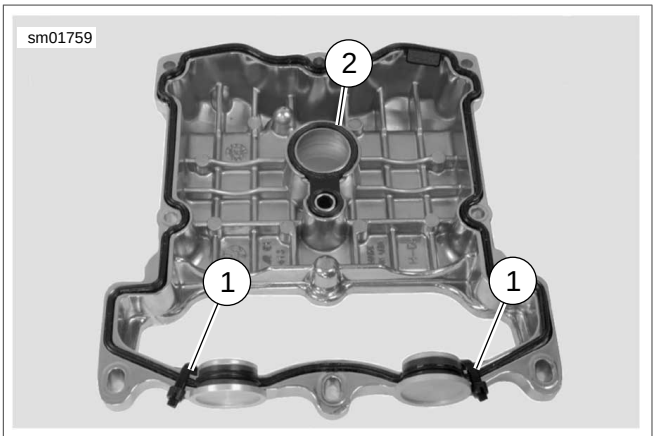
Figure 1-74. Cam Journal Caps

20. Rotate crankshaft two complete revolutions in the direction of normal rotation until cam lobes return to 10 o'clock and 2 o'clock positions.
21. Measure valve lash of all front cylinder cams and record "Final Lash Reading" on the worksheet.
22. Review the worksheet for the rear cylinder valves and make adjustments as needed.
23. After lash adjustment is complete, verify cam timing on both cylinders. See 1.20 VALVE LASH.
24. After verifying valve timing and lash adjustment is correct, install and tighten spark plugs to 23 Nm (17 ft-lbs).

NOTE

See Figure 1-76. The seal of the spark plug hole gasket is correct when the tapered edge of the gasket is in the cam cover and the double lipped side of the ring is facing out to mate with the flat of the cylinder head.

25. Clean cam cover and install **new** gasket.
26. See Figure 1-75. Use cable straps (1) to help retain gasket as shown.
27. See Figure 1-77. Insert GASKET ALIGNMENT DOWELS (Part No. HD-45340) into small hole in cylinder head next to spark plug hole.
28. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.
29. See Figure 1-75. Visually check to verify spark plug hole gasket (2) is in place.
30. Remove cable straps.
31. Place small cam cover in position on large cam cover.



1. **Cable straps**
2. **Spark plug hole gasket**

Figure 1-75. Cam Cover Gaskets



Figure 1-76. Spark Plug Hole Gasket (double lipped side)

32. See Figure 1-78. Insert fasteners in cam cover and tighten to 11 Nm (97 **in-lbs**) in sequence.
33. See Figure 1-53. Tighten front engine mount fastener to 38 Nm (28 ft-lbs).
34. Position the main harness along the left side of the frame and install cable straps.
35. Install front cylinder and rear cylinder breather hoses.
36. Install P-clamp around the right side radiator hoses and tighten fastener to 9.7 Nm (86 **in-lbs**).
37. Connect ground strap to cam cover. Tighten to 9.7 Nm (86 **in-lbs**).
38. Clip all wires and fuse blocks securely in place.

39. See Figure 1-79. Position intake clamps as shown.
40. Install throttle body and tighten clamps.
41. Install coils. See 1.15 SPARK PLUGS AND COIL.
42. Attach the idle air control (IAC) connector.
43. Attach the throttle position (TP) sensor.
44. Attach fuel lines.
 a. Insert fuel lines from injector back under frame and connect to fuel tank.
 b. Push connector onto fuel tank elbow until a "click" is heard.
 c. Install right angle connectors on rigid lines from injector. Push until a "click" is heard.
45. Install battery. See 1.24 BATTERY MAINTENANCE.
46. Install coolant overflow bottle.
47. Install air box assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

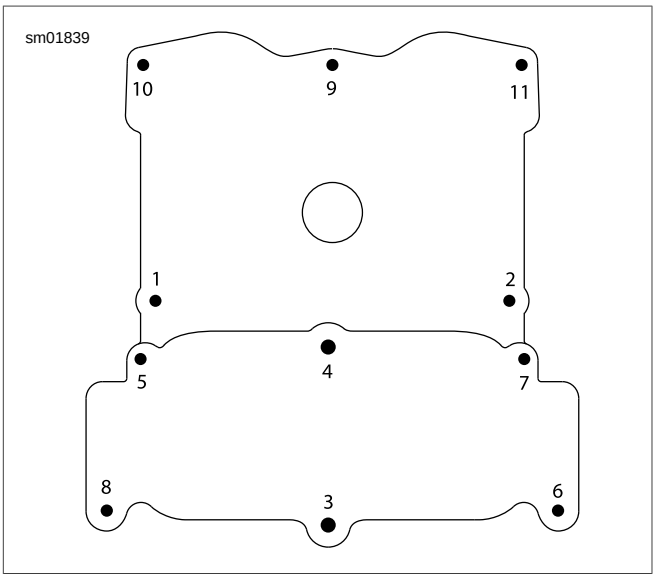


Figure 1-78. Cam Cover Torque Sequence

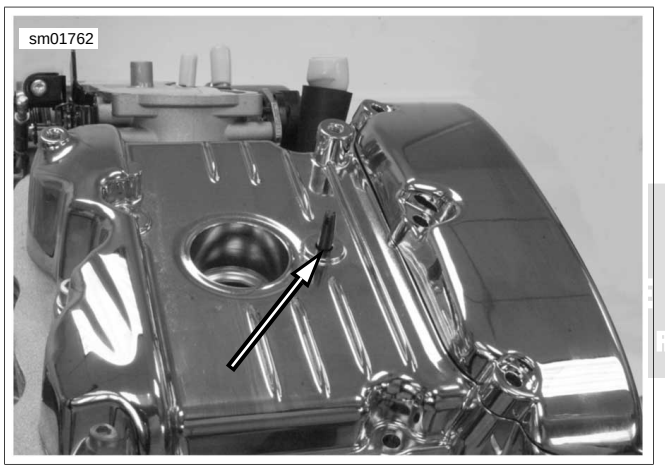


Figure 1-77. Gasket Alignment Tool (H-D-45340)

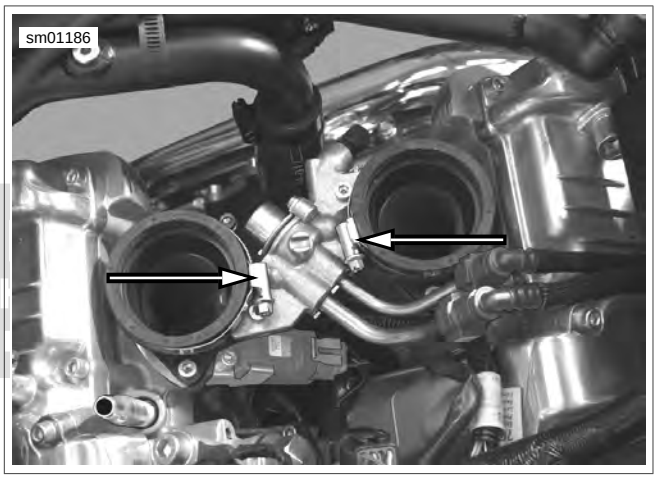


Figure 1-79. Intake Clamps, Throttle Body Removed (typical)

SECONDARY CAM CHAIN 1.21

GENERAL

On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, check secondary cam chain wear. Before beginning procedure, note if the rattle is heard during engine start-up.

ADJUSTMENT

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45334	SECONDARY CAM CHAIN MEASUREMENT TOOL

FASTENER	TORQUE VALUE	
Front cylinder secondary cam chain tensioner	100 Nm	74 ft-lbs

1. Support engine with a scissors jack under the frame at the fuel tank.
2. Remove the right side cover and main fuse. See 7.6 MAIN FUSE.
3. Open seat.
4. Remove air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.
6. Remove air filter top and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
7. Remove horn. See 7.26 HORN.
8. Remove derby cover from the left side crankcase cover.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

9. Position piston to adjust the secondary cam chain:
 a. See Figure 1-80. Install CRANKSHAFT ROTATING WRENCH (Part No. HD-45314).
 b. Hold the throttle wide open and watch front cylinder intake valve through intake port.
 c. Turn crankshaft in direction of normal rotation to open valve fully, then continue until valve closes.
 d. When the intake valve is seated, turn crankshaft an additional 1/4 turn (90 degrees).

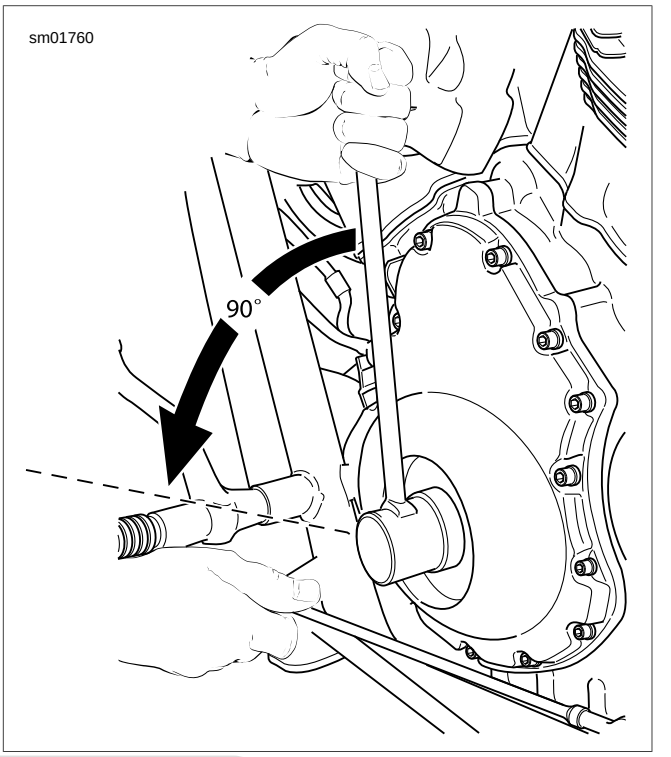


Figure 1-80. Positioning Piston

NOTES

- *Never rotate the engine without the secondary cam chain tensioner installed. Cam timing could be changed, causing engine damage.*
- *Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (Part No. HD-45334).*

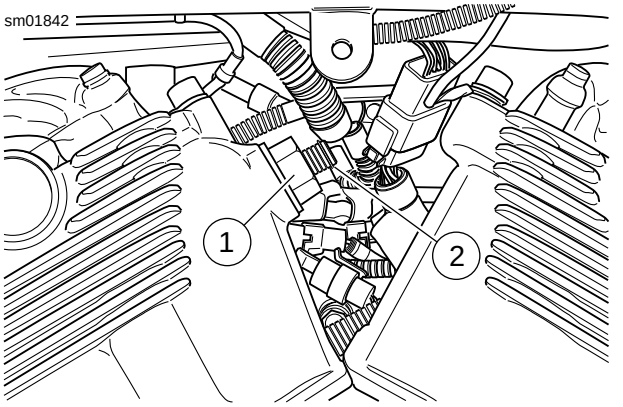
10. Remove the secondary cam chain tensioner.
11. See Figure 1-81. install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against the cylinder head.
12. Note the number of grooves showing on the tool.
13. Remove the SECONDARY CAM CHAIN MEASUREMENT TOOL.
14. Select the number of shims necessary for correct secondary cam chain tension. Refer to Table 1-11.

Table 1-11. Tensioner Shims

GROOVES	SHIMS REQUIRED
4	1*
3	2*
2	3
1	4
*Add shims ONLY if a start-up rattle is heard.	

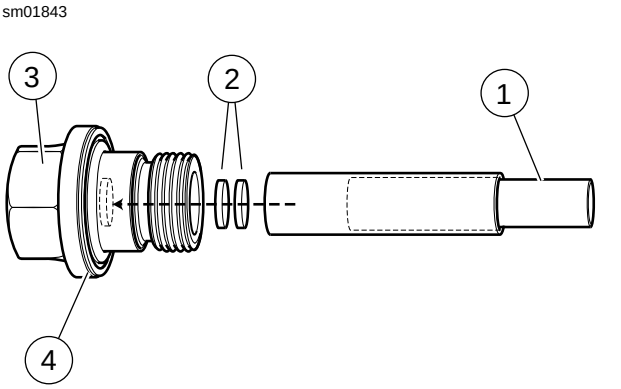
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15. See Figure 1-82. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
16. Apply a thin film of GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 to selected shims (2) and plunger (1).
17. Seat number of selected shims (2) and plunger (1) in tensioner (3).
18. Lubricate tensioner seal (4) with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50.
19. Install front cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).
20. Repeat procedure for rear cylinder.
21. Install horn. See 7.26 HORN.
22. Connect negative battery cable.
23. Install air filter components. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
24. Install the right side cover and main fuse.
25. Close seat.



1. **Secondary cam chain measurement tool**
2. **Visible grooves**

Figure 1-81. Secondary Cam Chain Measurement Tool Installed in Front Cylinder



1. **Plunger**
2. **Shims (as required)**
3. **Secondary cam chain tensioner**
4. **Seal**

Figure 1-82. Secondary Cam Chain Tensioner

HEADLAMP ALIGNMENT 1.22

HEADLAMP ALIGNMENT

⚠WARNING

The automatic-on headlamp feature provides increased visibility of the rider to other motorists. Be sure headlamp is on at all times. Poor visibility of rider to other motorists can result in death or serious injury. (00030b)

NOTE

Adjust the headlamps of motorcycles with multiple beam headlamps to converge into one pattern.

1. Make sure that front and rear tire inflation pressures are correct.
2. Make sure suspension is adjusted to the weight of the principal rider.
3. Fill fuel tank or add ballast to equal the weight of the fuel needed.

NOTE

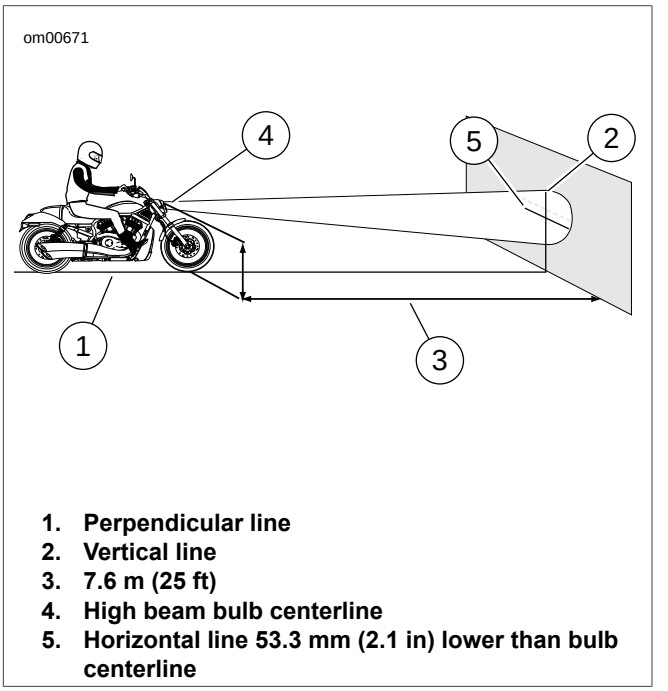
See Figure 1-83. To aid in properly placing the motorcycle, a perpendicular line (1) can be drawn on the floor. For best results, choose an area with minimum light.

4. Draw a vertical line (2) on the wall.
5. Position motorcycle so that front axle is 7.6 m (25 ft) from wall.

NOTE

As the weight of the rider will compress the suspension slightly, have a person whose weight is approximately the same as that of the principal rider sit on the motorcycle.

6. With the vehicle laden and upright, point the front wheel straight forward at wall and measure the distance (4) from the floor to the center of the HIGH BEAM bulb.
7. Draw a horizontal line (5) through the vertical line on the wall that is 53.3 mm (2.1 in) lower than the measured bulb centerline.
8. Verify headlamp alignment. With the motorcycle on, set the headlamp switch to HIGH beam.
 a. The center of the hot spot (brightest area of light beam) should be centered where the two lines intersect.
 b. Adjust headlamp alignment if necessary.



1. **Perpendicular line**
2. **Vertical line**
3. **7.6 m (25 ft)**
4. **High beam bulb centerline**
5. **Horizontal line 53.3 mm (2.1 in) lower than bulb centerline**

Figure 1-83. Headlamp Alignment: VRSC Models

HEADLAMP ADJUSTMENT

FASTENER	TORQUE VALUE	
Headlamp alignment fastener (typical)	4.5-7.5 Nm	40-66 **in-lbs**

1. See Figure 1-84 Loosen fasteners slightly so headlamp is still snug.
2. Move headlamp assembly to adjust vertical alignment.
3. Tighten fasteners to 4.5-7.5 Nm (40-66 **in-lbs**).



Figure 1-84. Headlamp Alignment Fastener

CRITICAL FASTENERS 1.23

INSPECTION

Inspect critical fasteners at the scheduled service intervals. Replace any fasteners that are damaged or missing.

Checking Torques on Fasteners

1. Attempt to turn the fastener using a torque wrench set to the minimum torque specification for that fastener. Refer to Table 1-12.
 a. If the fastener does not rotate, the fastener torque has been maintained. No further attention is necessary at this time.
 b. If the fastener rotates, remove it to determine if it has a locking agent.
 c. If it has a locking agent, clean all locking material from the threaded hole. Replace the fastener with a **new** one or clean the original fastener threads and apply the appropriate locking agent (see appropriate procedure).
 d. Install and tighten the fastener to specification.
2. If the fastener does not have a locking agent, install and tighten to specification.

Table 1-12. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Hand controls	Upper and lower switch housings	4.0-5.1 Nm	35-45 **in-lbs**
	Clutch lever handlebar clamp	8.0-9.0 Nm	70-80 **in-lbs**
	Master cylinder handlebar clamp	8.0-9.0 Nm	70-80 **in-lbs**
Brakes	Banjo bolts	23-29 Nm	17-22 ft-lbs
	Lower brake caliper mounting pin	38.0-51.5 Nm	28-38 ft-lbs
	Brake disc screws, front	23-31 Nm	17-23 ft-lbs
	Brake disc screws, rear	41-53 Nm	30-39 ft-lbs
	Reservoir screws	1.1-1.4 Nm	10-12 **in-lbs**
	Rear caliper mounting bolts	58-66 Nm	43-48 ft-lbs
	Rear master cylinder hex jamnut	41-54 Nm	30-40 ft-lbs
Axle nuts	Front axle	81-88 Nm	60-65 ft-lbs
	Rear axle	190-203 Nm	140-150 ft-lbs
Front fork/handlebars	Lower fork pinch bolts	44 Nm	32 ft-lbs
	Upper bracket pinch bolts	44 Nm	32 ft-lbs
Rear shock absorbers	Lower shock absorber bolts	41-68 Nm	31-50 ft-lbs
	Upper shock absorber bolts	41-68 Nm	31-50 ft-lbs
Other	Lower frame rail fasteners	61-75 Nm	45-55 ft-lbs
	Pivot shaft nut	61-75 Nm	45-55 ft-lbs

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BATTERY MAINTENANCE 1.24

GENERAL

⚠WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)

⚠WARNING

Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)

⚠WARNING

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm. Wash hands after handling. (00019e)

All AGM batteries are permanently sealed, maintenance-free, valve-regulated, lead/calcium and sulfuric acid batteries. The batteries are shipped pre-charged and ready to be put into service. Do not attempt to open these batteries for any reason.

NOTE

For charging information, see 1.24 BATTERY MAINTENANCE, Charging Battery. For testing information, see the electrical diagnostic manual.

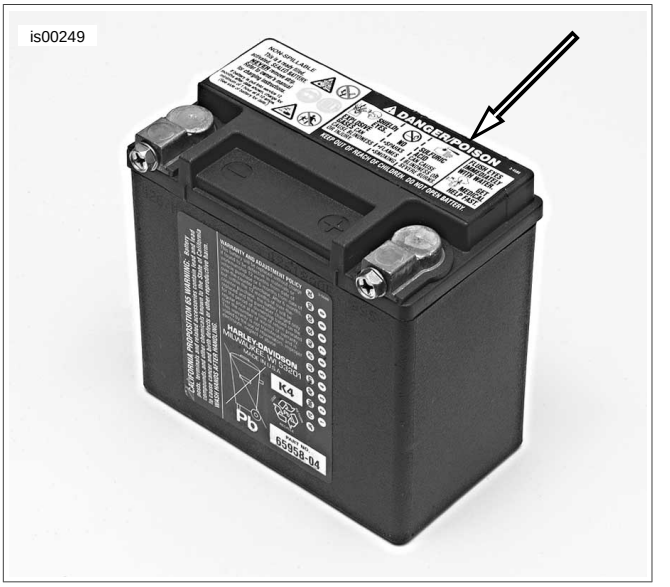
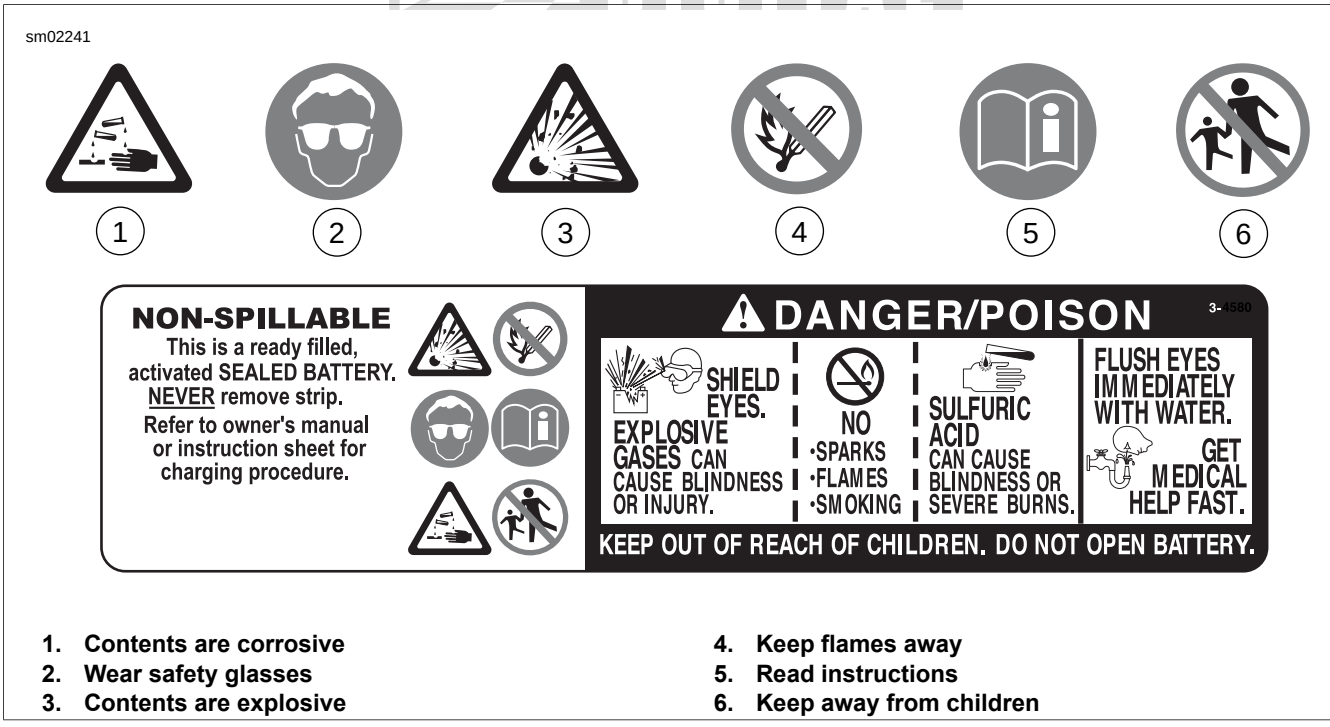


Figure 1-85. AGM Battery with Warning Label



1. Contents are corrosive
2. Wear safety glasses
3. Contents are explosive
4. Keep flames away
5. Read instructions
6. Keep away from children

Figure 1-86. Battery Warning Label

Table 1-13. Antidotes for Battery Acid

CONTACT	TREATMENT
External	Flush with water.
Internal	Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Get immediate medical attention.
Eyes	Flush with water. Get immediate medical attention.

DISCONNECTION/REMOVAL

1. Remove air box cover, right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove complete air box and air box stud. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

3. See Figure 1-87. Cover throttle body bores (injector bore).

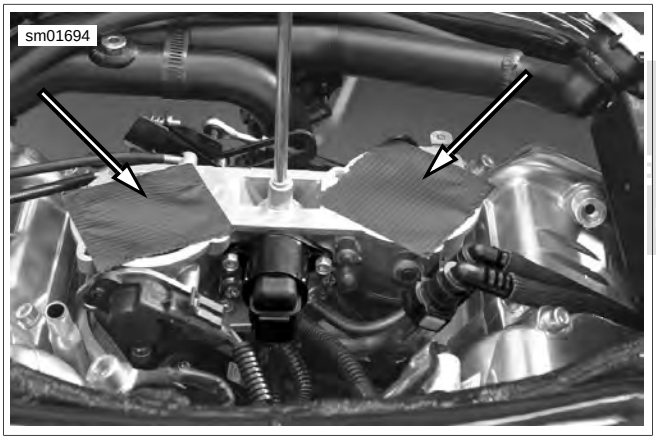
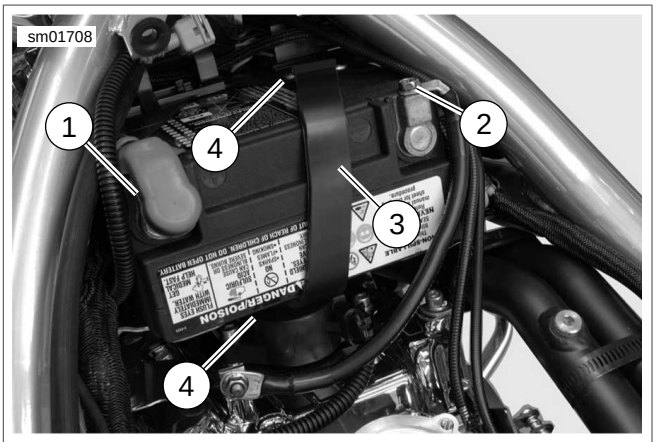


Figure 1-87. Air Box Removed (Throttle body bores shown by arrows)

⚠WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

4. See Figure 1-88. Remove negative and positive battery terminal bolts.
5. Remove battery hold down strap.
6. Firmly pull battery out and slightly upward to remove battery from battery caddy.
7. Check battery voltage and make sure it is at recommended specification. Charge battery at rate and time specified as required.



1. **Positive battery terminal hold down bolt (located under boot)**
2. **Negative battery terminal bolt**
3. **Hold down strap**
4. **Tabs**

Figure 1-88. Battery Removal (typical)

CLEANING AND INSPECTION

1. Battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause battery to self-discharge. Clean battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water). When the solution stops bubbling, rinse off the battery with clean water.
2. Clean cable connectors and battery terminals using a wire brush or sandpaper. Remove any oxidation.
3. Inspect the battery screws, clamps and cables for breakage, loose connections and corrosion. Clean clamps.
4. Check the battery posts for melting or damage caused by overtightening.
5. Inspect the battery for discoloration, raised top or a warped or distorted case. This might indicate that the battery has been frozen, overheated or overcharged.
6. Inspect the battery case for cracks or leaks.

VOLTMETER TEST

⚠WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)

⚠WARNING

Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)

Voltmeter Test

The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is fully

charged. If the open circuit (disconnected) voltage reading is below 12.6 V, charge the battery and check the voltage after the battery has set for one to two hours. If the voltage reading is 12.7 V or above, perform a load test. See the electrical diagnostic manual for the load test procedure. Refer to Table 1-14.

Table 1-14. Voltmeter Test For Battery Charge Conditions

VOLTAGE (OCV)	STATE OF CHARGE
12.7 V	100%
12.6 V	75%
12.3 V	50%
12.0 V	25%
11.8 V	0%

CHARGING BATTERY

Safety Precautions

Always review charger instructions before charging a battery. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger off before connecting or disconnecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery: red positive (+) lead to the positive (+) terminal and black negative (-) lead to the negative (-) terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.
- Make sure that the charger leads to the battery are not separated, frayed or loose.
- If the battery temperature exceeds 43 °C (110 °F) during charging, discontinue charger and allow the battery to cool.

Using a Battery Charger

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.

⚠WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)

NOTICE

If battery releases an excessive amount of gas during charging, decrease the charging rate. Overheating can result in plate distortion, internal shorting, drying out or damage. (00413b)

1. Check charge state with voltmeter test. See the electrical diagnostic manual. If battery needs to be charged, proceed to the next step.

NOTES

- *Charge times may vary. When using an appropriate automatic charger, allow the charger to determine when charging is complete. Refer to Table 1-15.*
- *Do not use battery chargers that produce excessively high voltage designed for flooded batteries or excessively high current designed for much larger batteries. Charging should be limited to no more than 5 amps at no more than 14.6 volts.*

⚠WARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

NOTICE

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged. (00214a)

2. Connect red battery charger lead to the positive (+) terminal and black battery charger lead to the negative (-) terminal of the battery.

NOTE

If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.

3. Step away from the battery and turn on the charger.

⚠WARNING

Unplug or turn OFF battery charger before disconnecting charger cables from battery. Disconnecting clamps with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)

4. After the battery is fully charged, turn the charger OFF. Disconnect the black battery charger lead to the negative (-) terminal of the battery.
5. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
6. Mark the charging date on the battery.
7. Perform either a conductance test or load test to determine the condition of the battery. See the electrical diagnostic manual.

8. If charging a battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See the electrical diagnostic manual.

Table 1-15. 19 Amp-Hour Battery Charging Rates/Times (Approximate)

READING (VOLTS)	PERCENT OF CHARGE	5 AMP CHARGER	2 AMP CHARGER	1.5 AMP CHARGER	0.75 AMP CHARGER
12.7	100	-	-	-	-
12.6	75	2 hours	3 hours 24 minutes	4 hours 12 minutes	7 hours 18 minutes
12.3	50	2 hours 54 minutes	5 hours 48 minutes	7 hours 18 minutes	13 hours 42 minutes
12.0	25	3 hours 54 minutes	8 hours 6 minutes	10 hours 30 minutes	20 hours
11.8	0	4 hours 48 minutes	10 hours 30 minutes	13 hours 42 minutes	26 hours 18 minutes

INSTALLATION/CONNECTION

FASTENER	TORQUE VALUE	
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**

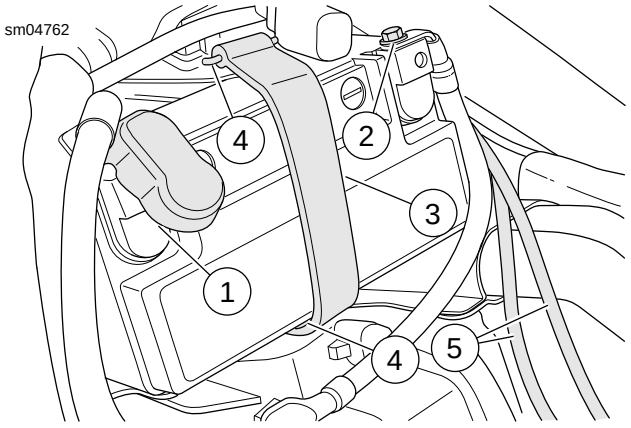
NOTICE

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

NOTICE

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

1. See Figure 1-89. Insert battery into tray into battery caddy.
2. Connect hold down strap to bottom of battery caddy.
3. Install battery with terminals facing upward.



1. **Positive battery teminal hold down bolt (located under boot)**
2. **Negative battery terminal bolt**
3. **Hold down strap**
4. **Tabs (strap anchor points, one located under battery tray)**
5. **Throttle cables**

Figure 1-89. Battery Installed

4. Verify proper routing of throttle cables.
5. Latch hold down strap to tab on top of battery caddy.

WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

6. Connect battery cables, positive first. Tighten terminal bolts to 6.8-7.9 Nm (60-70 **in-lbs**) and cover terminal with protective terminal boot.

NOTE

Battery must sit flat on bottom of tray pad. Verify that battery does not sit on front edge of tray pad.

7. Remove covering over throttle bodies.
8. Install airbox. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
9. Install main fuse and side cover.
10. Close seat.

STORAGE

PART NUMBER	TOOL NAME
99863-01A	GLOBAL BATTERY CHARGER

WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)

If the motorcycle is to be stored with the security system armed, connect a GLOBAL BATTERY CHARGER (Part No. 99863-01A) to maintain battery charge.

If the motorcycle is to be stored with the battery installed, without a GLOBAL BATTERY CHARGER, and with the security system **not** armed, remove the main fuse.

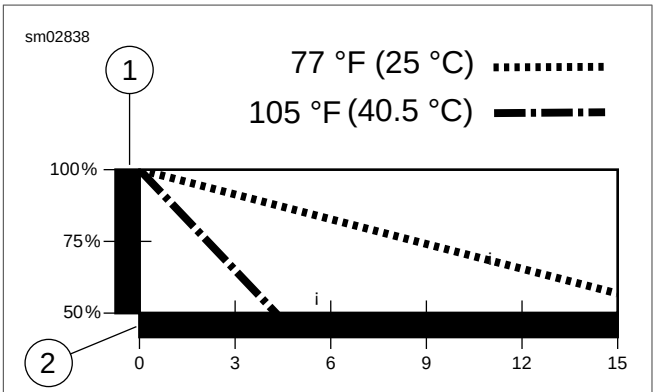
If the motorcycle will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge.

See Figure 1-90. A battery that is removed from the vehicle is affected by self-discharge. A battery that is stored in the vehicle is affected by self-discharge and, more significantly, by parasitic loads. A parasitic load is generated by such things as diode leakage or maintaining computer memory with the vehicle turned off. Batteries self-discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool, dry place.

Charge the battery once per month if stored in the vehicle. Charge the battery every three months if stored out of the vehicle.

NOTES

- *Use the GLOBAL BATTERY CHARGER (Part No. 99863-01A) to maintain battery charge for extended periods of time without risk of overcharging or boiling.*
- *When returning a battery to service after storage, see the electrical diagnostic manual.*



1. **Capacity**
2. **Months of non-use**

Figure 1-90. Battery Self-Discharge Rate

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STORAGE 1.25

GENERAL

Always prepare motorcycle for extended storage following service manual procedures. This will help protect parts against corrosion, preserve the battery and prevent buildup of gum and varnish in the fuel system.

PLACING IN STORAGE

⚠WARNING

Do not store motorcycle with gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00003a)

⚠WARNING

Avoid spills. Slowly remove filler cap. Do not fill above bottom of filler neck insert, leaving air space for fuel expansion. Secure filler cap after refueling. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00028a)

⚠WARNING

Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)

1. Prepare the fuel system by filling fuel tank and adding a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions.
2. Run motorcycle until engine is at normal operating temperature. Stop the engine and change the engine oil and filter.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Install spark plugs.
4. Inspect drive belt deflection. See 1.10 DRIVE BELT AND SPROCKETS.
5. Inspect drive belt and sprockets.
6. Inspect air cleaner filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
7. Lubricate controls. See 1.12 CABLE, LINE AND FRAME INSPECTION.
8. Inspect operation of all electrical equipment and switches.
9. Check tire inflation and inspect tires for wear and/or damage. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires. See 1.8 TIRES AND WHEELS.
10. Wash painted and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.

⚠WARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

⚠WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)

11. Remove the battery from the vehicle. Charge the battery until the correct voltage is obtained. Charge the battery every other month if it is stored at temperatures below 16 °C (60 °F). Charge battery once a month if it is stored at temperatures above 16 °C (60 °F). See 1.24 BATTERY MAINTENANCE.

⚠WARNING

Unplug or turn OFF battery charger before disconnecting charger cables from battery. Disconnecting clamps with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)

12. If the motorcycle is to be covered, use a material that will breathe, such as a Harley-Davidson storage cover or light canvas. Plastic materials that do not breathe promote the formation of condensation which leads to corrosion.

REMOVAL FROM STORAGE

⚠WARNING

The clutch failing to disengage can cause loss of control, which could result in death or serious injury. Prior to starting after extended periods of storage, place transmission in gear and push vehicle back and forth several times to assure proper clutch disengagement. (00075a)

1. Charge and install the battery.
2. Remove and inspect the spark plugs. Replace if necessary.
3. Clean the air cleaner element.
4. If fuel tank was drained, fill fuel tank with fresh gasoline.
5. Start the engine and run until it reaches normal operating temperature.
6. Check engine oil level. Fill to proper level with correct fluid if required.
7. Perform all of the checks in the PRE-RIDING CHECKLIST in the owner's manual.

TROUBLESHOOTING 1.26

GENERAL

⚠WARNING

The Troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury. (00528b)

Refer to the following checklists when troubleshooting motorcycle. More than one of these conditions may be causing the trouble and all should be carefully checked.

NOTES

- *For further troubleshooting information, see the electrical diagnostics manual.*
- *For troubleshooting the cooling system, review the check list of operating troubles in 5.3 COOLANT FLOW.*

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Ignition switch not in ON position.
2. Engine run switch in OFF position.
3. Main fuse not in place.
4. Discharged battery, loose or corroded connections (solenoid chatters).
5. Starter control circuit, relay, or solenoid faulty.
6. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
7. Starter limiter gear seized.
8. TSM/TSSM/HFSM Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fuel filter clogged.
3. Fouled spark plugs.
4. Sticking or damaged valve.
5. Discharged battery, loose or inoperative battery terminal connections.
6. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

7. Loose wire connection at coil(s), battery or ECM connector.
8. Ignition timing incorrect due to faulty coil(s), ECM or sensors (MAP, CKP and/or TSM/TSSM/HFSM).
9. Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.

Starts Hard

1. Spark plugs in bad condition or have improper gap or are partially fouled.
2. Battery nearly discharged.
3. Loose wire connection at one of the battery terminals, coil(s) or ECM connector.
4. Water or dirt in fuel system.
5. Intake air leak.
6. Fuel tank vent hose and vapor valve plugged, or fuel line closed off, restricting fuel flow.
7. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

8. Ignition not functioning properly (possible sensor failure).
9. Faulty ignition coil(s).
10. Valves sticking or valves too tight.
11. Rotor key sheared.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug gap too close or too wide.
3. Faulty ignition coil(s), ECM, or sensor.
4. Battery nearly discharged.
5. Damaged wire or loose connection at battery terminals, coil(s) or ECM connector.
6. Intermittent short circuit due to damaged wire insulation.
7. Water or dirt in fuel system.
8. Fuel tank vent system plugged.
9. Air leak at intake manifold or air filter.
10. Loose or dirty ECM connector.
11. Faulty Sensor(s): Manifold Absolute Pressure (MAP) or Crank Position (CKP).
12. Incorrect valve timing.
13. Weak or inoperative valve springs.
14. Damaged intake or exhaust valve.

Spark Plug Fouls Repeatedly

1. Fuel mixture too rich.
2. Incorrect spark plug for the kind of service.
3. Piston rings badly worn or inoperative.
4. Valve guides or seals badly worn.

Pre-Ignition or Detonation (Knocks or Pings)

1. Fuel octane rating too low.

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2. Faulty spark plugs.
3. Incorrect spark plug for the kind of service.
4. Excessive carbon deposit on piston head or in combustion chamber.
5. Ignition timing advanced due to faulty sensors (MAP and/or CKP).
6. Air leak.

Overheating

1. Insufficient oil supply or oil not circulating.
2. Insufficient air flow over engine.
3. Heavy carbon deposit.
4. Ignition timing retarded due to faulty sensor(s): Manifold Absolute Pressure (MAP) and/or Crank Position (CKP).
5. Leaking valve.
6. Radiator dirty, plugged.
7. Insufficient coolant supply.
8. Loose triple sprocket fastener.
9. Vent hose crimped.
10. Air in cooling system.

Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
2. Valve sticking in guide.
3. Chain tensioning spring or shoe worn.
4. Cam timing incorrect.
5. Secondary cam tensioner out of range.

Excessive Vibration

1. Wheels and/or tires worn or damaged.
2. Engine/transmission/rear wheel not aligned properly.
3. Upper engine mounting bracket loose/inoperative or mounting bracket pre-loaded.
4. Ignition timing advanced due to faulty sensor inputs (MAP and/or CKP)/poorly tuned engine.
5. Internal engine problem.
6. Inoperative frame.
7. Engine counterbalancer out of time or bearing failed.
8. Exhaust system binding or hitting frame.

Check Engine Light Illuminates During Operation

Fault detected. See the electrical diagnostic manual.

LUBRICATION SYSTEM

Engine Uses Too Much Oil Or Smokes Excessively

1. Restricted breather operation.
2. Restricted oil filter.
3. Piston rings badly worn or broken.
4. Valve guides or seals worn.
5. Oil diluted with gas.

Engine Leaks Oil From Cases, Hoses, Etc.

1. Loose parts.
2. Imperfect seal at gaskets, washers, etc.
3. Restricted breather hose to air filter.
4. Restricted oil filter.
5. Porosity.

Low Oil Pressure

1. Oil sump underfilled.
2. Faulty low oil pressure switch.
3. Oil pump O-ring damaged or missing.
4. Bypass valve stuck in open position.
5. Oil diluted with gas.
6. Open in oiling circuit.

High Oil Pressure

1. Oil sump overfilled.
2. Bypass valve stuck in closed position.

ELECTRICAL SYSTEM

NOTE

For diagnostic information see the electrical diagnostic manual.

Alternator Does Not Charge

1. Voltage regulator module not grounded.
2. Engine ground wire loose or damaged.
3. Faulty voltage regulator module.
4. Loose or damaged wires in charging circuit.
5. Faulty stator and/or rotor.

Alternator Charge Rate Is Below Normal

1. Weak or damaged battery.
2. Loose connections.
3. Faulty voltage regulator module.
4. Faulty stator and/or rotor.

Speedometer Operates Erratically

1. Contaminated vehicle speed sensor (remove sensor and clean off metal particles).

2. Loose connections.

TRANSMISSION

Shifts Hard

1. Clutch dragging slightly.
2. Shifter return spring (inside transmission) bent or inoperative.
3. Bent shifter rod.
4. Shifter forks (inside transmission) sprung.
5. Corners worn off shifter clutch dogs (inside transmission).
6. Hydraulic clutch circuit not bled correctly.

Jumps Out Of Gear

1. Shifter rod improperly adjusted.
2. Shifter drum (inside transmission) damaged.
3. Shifter engaging parts (inside transmission) badly worn and rounded.
4. Shifter forks bent.
5. Damaged gears.

Clutch Slips

1. Insufficient clutch spring tension.
2. Worn friction discs.
3. Air in clutch line.

Clutch Drags Or Does Not Release

1. Fluid level too high in master cylinder.
2. Clutch spring tension.
3. Clutch discs warped.
4. Clutch spacer missing or installed backwards.

Clutch Chatters

Friction discs or steel discs worn or warped.

HANDLING

Irregularities

1. Improperly loaded motorcycle. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage tends to cause unstable handling.
2. Damaged tire(s) or improper front-rear tire combination.
3. Irregular or peaked front tire tread wear.
4. Incorrect tire pressure. See 1.8 TIRES AND WHEELS.
5. Shock absorber not functioning normally.
6. Loose wheel axle nuts. Tighten to recommended torque specification.
7. Excessive wheel hub bearing play.
8. Rear wheel out of alignment with frame and front wheel.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See 1.19 STEERING HEAD BEARINGS.
10. Tire and wheel unbalanced.
11. Rims and tires out-of-round or eccentric with hub.
12. Rims and tires out-of-true sideways.
13. Rear fork loose on pivot shaft.

BRAKES

Brake Does Not Hold Normally

1. Brake fluid reservoir low, system leaking or pads worn.
2. Brake system contains air bubbles.
3. Master cylinder/caliper piston seals worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn.
6. Brake disc badly worn or warped.
7. Brake drags - insufficient brake pedal or hand lever freeplay, caliper piston worn or damaged, or excessive brake fluid in reservoir.
8. Brake fades due to heat build up - brake pads dragging or excessive braking.
9. Brake fluid leak when under pressure.

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NOTES

FASTENER TORQUE VALUES 2.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Banjo bolt	23-31 Nm	17-23 ft-lbs	2.14 CLUTCH FLUID LINE, Installation
Banjo bolt	23-31 Nm	17-23 ft-lbs	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.4 LOWER FRAME RAILS, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.5 FRONT ENGINE MOUNT, Replacement
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.7 REAR ENGINE MOUNTS, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.32 FRONT FORK, Installation
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Belt guard fasteners	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Belt guard grommet bolt	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Bleed screw	9-11 Nm	80-100 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Bleed screw	9-11 Nm	80-100 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Brake caliper bleeder valve	9.0-11.3 Nm	80-100 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Brake disc bolts, front	22-23 Nm	16-24 ft-lbs	2.25 FRONT WHEEL, Assembly
Brake disc bolts, rear	41-53 Nm	30-38 ft-lbs	2.26 REAR WHEEL, Assembly
Brake line banjo bolt, front caliper	23-26 Nm	17-19 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Center mounting bolt	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**	2.14 CLUTCH FLUID LINE, Installation
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Clutch master cylinder/reservoir, banjo bolt	17-20 Nm	13-14 ft-lbs	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Clutch master cylinder/reservoir, reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Clutch reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Compensator bowl screws (final torque)	102-115 Nm	75-85 ft-lbs	2.26 REAR WHEEL, Assembly
Compensator bowl screws (initial torque)	75-88 Nm	55-65 ft-lbs	2.26 REAR WHEEL, Assembly
Coolant air bleed plug	9-11 Nm	80-97 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, cross member fasteners	20-26 Nm	15-19 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Cooling system, hose worm drive clamps	3-4 Nm	27-35 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, P-clamp	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, pipe clamp	6.5 Nm	57 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, pipe connecting clamp	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation

FASTENER	TORQUE VALUE		NOTES
Cooling system, top mounting flange nuts	19-27 Nm	15-20 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Cross member mounting bolts	20-26 Nm	15-19 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	2.26 REAR WHEEL, Installation
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine crankcase end of stabilizer link	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount double threaded studs	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Engine mount double-threaded studs	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount to bracket	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Disassembly And Assembly
Fender, inner fasteners	95-110 Nm	75-81 ft-lbs	2.39 REAR FENDER, Installation
Fender mounting fasteners	20-26 Nm	15-19 ft-lbs	2.39 REAR FENDER, Installation
Fender to fork brace, front	4.1-6.8 Nm	36-60 **in-lbs**	2.31 FRONT FENDER, All Models/Tighten in cross pattern.
Footrest bracket/stud plate nuts	19-27 Nm	14-20 ft-lbs	2.10 PASSENGER FOOTRESTS, Passenger Footrests: VRSCF
Footrest bracket socket head capscrews	55-70 Nm	40-52 ft-lbs	2.10 PASSENGER FOOTRESTS, Passenger Footrests: All except VRSCF
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs	2.9 RIDER FOOTRESTS AND FOOT CONTROLS, Rider Footrests
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs	2.9 RIDER FOOTRESTS AND FOOT CONTROLS, Rider Footrests
Fork brace to forks, front	20-26 Nm	15-19 ft-lbs	2.31 FRONT FENDER, All Models
Fork cap	29-39 Nm	21.3-28.8 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap into fork
Fork cap	29-39 Nm	21.3-28.8 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap into fork
Fork cartridge fastener	15-25 Nm	132-221 **in-lbs**	2.32 FRONT FORK, Assembly
Front axle pinch bolt	55-65 Nm	41-48 ft-lbs	2.25 FRONT WHEEL, Installation
Front brake caliper bottom mounting bolt	43-52 Nm	32-38 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Front brake caliper top mounting bolt	43-52 Nm	32-38 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Front brake hose bracket bolt	6-10 Nm	53-89 **in-lbs**	2.33 STEERING HEAD, Installation
Front brake master cylinder banjo bolt	17-20 Nm	13-15 ft-lbs	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Front brake master cylinder cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Front engine drain plug	9.7 Nm	86 **in-lbs**	2.8 ENGINE REPLACEMENT, Removal
Front engine mount bolts	34-41 Nm	25-30 ft-lbs	2.5 FRONT ENGINE MOUNT, Replacement
Front master cylinder reservoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Front wheel axle nut	81-99 Nm	60-73 ft-lbs	2.25 FRONT WHEEL, Installation
Grabstrap	20-26 Nm	14-19 ft-lbs	2.38 SEAT, Installation
Ground cable terminal ring nut bolt	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Handlebar (VRSCDX), cast riser fasteners	41-47 Nm	31-35 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation

FASTENER	TORQUE VALUE		NOTES
Handlebar (VRSCDX) clamp, front fasteners	16-20 Nm	12-15 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation/First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque.
Handlebar (VRSCDX) clamp, rear fasteners	16-20 Nm	12-15 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation/First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque.
Handlebar clamp and master cylinder housing screws	8-9 Nm	71-80 **in-lbs**	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Handlebar clamp screws	8-9 Nm	71-80 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Handlebars (VRSCF) bolts	41-47 Nm	31-35 ft-lbs	2.23 HANDLEBARS: VRSCF, Installation
Headlamp bracket fasteners, VRSCF	11-18 Nm	108-156 **in-lbs**	2.23 HANDLEBARS: VRSCF, Installation
Inner fork nut	93-113 Nm	69-83 ft-lbs	2.32 FRONT FORK, Assembly/Hand tighten. Then tighten to torque.
Instrument cluster housing fasteners	4-7 Nm	35.4-62.0 **in-lbs**	2.23 HANDLEBARS: VRSCF, Installation
Jiffy stand anchor	7-9 Nm	62-79 **in-lbs**	2.41 JIFFY STAND, Installation
License plate bracket fasteners (VRSCF) (Non-DOM)	8-12 Nm	70.7-106.1 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Non-Domestic
License plate bracket fasteners (VRSCF-DOM)	9-11 Nm	80-97 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Domestic Only
Lower frame rail bolts	61-75 Nm	45-55 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Lower frame rail bolts (final torque)	61-75 Nm	45-55 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Lower frame rail bolts (initial torque)	61-75 Nm	45-55 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Oil drain plug	35 Nm	25 ft-lbs	2.8 ENGINE REPLACEMENT, Removal
Passenger pillion fasteners	6-10 Nm	53-88 **in-lbs**	2.39 REAR FENDER, Installation
Pillion mounting nut	6-10 Nm	53-88 **in-lbs**	2.38 SEAT, Installation
Pivot shaft nut	61-75 Nm	45-55 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Pivot shaft nut	61-75 Nm	45-55 ft-lbs	2.37 REAR FORK, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	2.26 REAR WHEEL, Installation
Rear brake caliper banjo bolt	23-26 Nm	17-19 ft-lbs	2.20 REAR BRAKE CALIPER, Installation
Rear brake caliper fastener	58-66 Nm	43-48 ft-lbs	2.20 REAR BRAKE CALIPER, Removal
Rear brake master cylinder banjo bolt	23-26 Nm	17-19 ft-lbs	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear brake master cylinder jam nut	41-54 Nm	30-40 ft-lbs	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear brake reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear engine mount fasteners	34-41 Nm	25-30 ft-lbs	2.7 REAR ENGINE MOUNTS, Installation
Rear master cylinder reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Reservoir banjo bolt	23-31 Nm	17-23 ft-lbs	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Resevoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.18 FRONT BRAKE CALIPER, Installation
Retainer nut, left side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap against retainer nut

FASTENER	TORQUE VALUE		NOTES
Retainer nut, right side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap against retainer nut
Seat retaining post	6-10 Nm	53-88 **in-lbs**	2.38 SEAT, Installation
Secondary clutch actuator, bleed screw	9-11 Nm	80-97 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Secondary clutch actuator cover mounting bolts	6-10 Nm	53-88 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Secondary clutch actuator fasteners	10 Nm	88 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Shifter arm clamp bolt	14-16 Nm	132-144 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Shifter linkage to shifter arm bolt	9-15 Nm	80-133 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Shift linkage fastener	9-15 Nm	80-133 **in-lbs**	2.9 RIDER FOOTRESTS AND FOOT CONTROLS, Rider Footrests
Shock mount fasteners	41-68 Nm	31-50 ft-lbs	2.36 REAR SHOCK ABSORBERS, Installation
Solenoid cable terminal ring	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Spring washers	22-33 Nm	16-24 ft-lbs	2.25 FRONT WHEEL, Assembly
Stabilizer link ball end lock nuts (2)	34-41 Nm	25-30 ft-lbs	2.30 WHEEL ALIGNMENT, Centering Engine
Stabilizer link to frame tab fastener	34-41 Nm	25-30 ft-lbs	2.30 WHEEL ALIGNMENT, Centering Engine
Stabilizer to frame tab	34-41 Nm	25-30 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Starter solenoid mounting	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Steering stem pinch bolt (initial torque)	34 Nm	25.0 ft-lbs	2.32 FRONT FORK, Installation
Steering stem pinch bolt (second step)	8-11 Nm	70.8-97.3 **in-lbs**	2.32 FRONT FORK, Installation
Stud plate nuts	8-12 Nm	70.7-106.1 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Non-Domestic
Throttle body clamp fasteners	1.25 Nm	11 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Throttle housing screws	4-5 Nm	35-45 **in-lbs**	2.11 THROTTLE CABLES, Assembly and Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Valve stem nut	1.4-1.7 Nm	12-15 **in-lbs**	2.29 TIRES, Installation

SPECIFICATIONS: CHASSIS 2.2

GENERAL

Table 2-1. Dimensions

ITEM	VRSCDX, VRSCDX ANV		VRSCF	
	IN.	MM	IN.	MM
Wheelbase	67.0	1702	67.0	1702
Road clearance	4.8	122	4.8	122
Seat height*	25.6	650	25.6	650
*With 82 kg (180 lb.) rider on seat.				

Table 2-2. Weights

ITEM	VRSCDX, VRSCDX ANV		VRSCF	
	LB.	KG	LB.	KG
Running weight*	670	304.0	673	305.3
Maximum added weight allowed**	405	183.6	402	182.3
GVWR	1075	487.6	1075	487.6
GAWR Front	377	171.0	377	171.0
GAWR Rear	698	317.6	698	317.6
*The total weight of the motorcycle as delivered with oil/fluids and approximately 90% of fuel. **The total weight of accessories, cargo, riding gear, passenger and rider cannot exceed this weight.				

WARNING

Do not exceed the motorcycle's Gross Vehicle Weight Rating (GVWR) or Gross Axle Weight Rating (GAWR). Exceeding these weight ratings can lead to component failure and adversely affect stability, handling and performance, which could result in death or serious injury. (00016f)

- GVWR is the sum of the weight of the motorcycle, accessories, and the maximum weight of the rider, passenger and cargo that can be safely carried.
- GAWR is the maximum amount of weight that can be safely carried on each axle.
- The GVWR and GAWR are shown on the information plate, located on the left front frame cross tube.

NOTES

- *The maximum additional weight allowed on the motorcycle equals the Gross Vehicle Weight Rating (GVWR) minus the running weight. For example, a motorcycle with GVWR of 544 kg (1200 lbs) having a running weight of 363 kg (800 lbs), would allow a maximum of an additional 181 kg (400 lbs) combined weight of the rider, passenger, riding gear, cargo and installed accessories.*

Table 2-3. Capacities

ITEM	U.S.	LITERS
Fuel tank	5.0 gal	18.9
Low fuel warning lamp on	0.5 gal	1.9
Oil capacity with filter	5.0 qt.	4.7
Coolant capacity	2.5 qt.	2.4

Table 2-4. Wheel, Brake Disc and Tire Runout

RUNOUT	MM	IN
Wheel - rim lateral	0.76	0.030
Wheel - rim radial	0.76	0.030
Front brake disc - lateral	0.2	0.008
Rear brake disc - lateral	0.2	0.008
Tire - lateral	1.52	0.060
Tire - radial	2.29	0.090

WARNING

Be sure tires are properly inflated, balanced, undamaged, and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced, improperly inflated, overloaded or damaged tires can lead to tire failure and adversely affect stability and handling, which could result in death or serious injury. (00014b)

Table 2-5. Specified Tires

MOUNT	SIZE	SPECIFIED TIRE	PRESSURE (COLD)	
			PSI	kPa
Front	19 in.	Michelin Scorcher "11" 120/70ZR-19 60W	36	248
Rear	18 in.	Michelin Scorcher "11" 240/40R-18 79V	42	290

⚠WARNING

Match tires, tubes, rim strips or seals, air valves and caps to the correct wheel. Contact a Harley-Davidson dealer. Mismatching can lead to tire damage, allow tire slippage on the wheel or cause tire failure, which could result in death or serious injury. (00023c)

NOTE

See 1.8 TIRES AND WHEELS for important information regarding tires.

⚠WARNING

Use only Harley-Davidson specified tires. See a Harley-Davidson dealer. Using non-specified tires can adversely affect stability, handling or braking, which could result in death or serious injury. (00024b)

- Use tubeless tires on all Harley-Davidson disc wheels.
- Do not use inner tubes in radial tires.
- Always use the correct size tires. Tire sizes are molded on the tire sidewall.

NOTE

ABS equipped motorcycles must always use tires and wheels that are the same as the original equipment. The ABS system monitors rotational speed of the wheels through individual wheel speed sensors to determine the application of ABS. Changing to different diameter wheels or different size tires can alter the rotational speed and upset the calibration of the ABS, resulting in an adverse effect on its ability to detect and prevent lockups. Operating with inflation pressure other than those specified in Table 2-5 can reduce ABS performance.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

VEHICLE IDENTIFICATION NUMBER (V.I.N.) 2.3

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

General

See Figure 2-2. A unique 17-digit serial or Vehicle Identification Number (V.I.N.) is assigned to each motorcycle. For a description of each item in the V.I.N., refer to Table 2-6.

Location

See Figure 2-1. The full 17-digit V.I.N. is stamped on the right side of the frame on the steering head. In some destinations, a printed V.I.N. label is also attached to the left frame tube above the front engine cylinder.

Abbreviated V.I.N.

An abbreviated V.I.N. showing the vehicle model, engine type, model year, and sequential number is stamped on the left side of the crankcase below the rear cylinder head.

NOTE

Always give the full 17-digit Vehicle Identification Number when ordering parts or making any inquiry about your motorcycle.

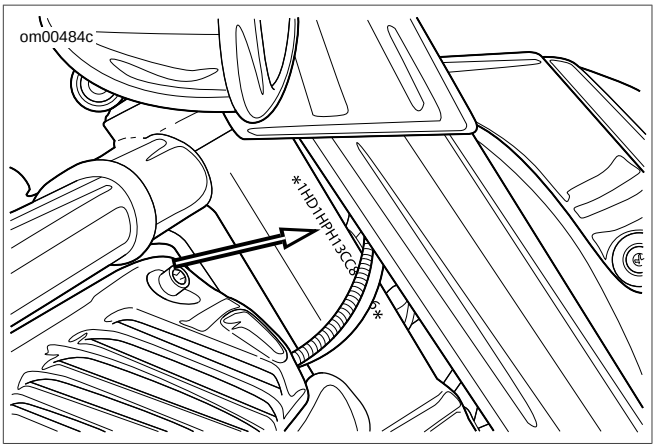


Figure 2-1. V.I.N. Stamping Location: VRSC Models

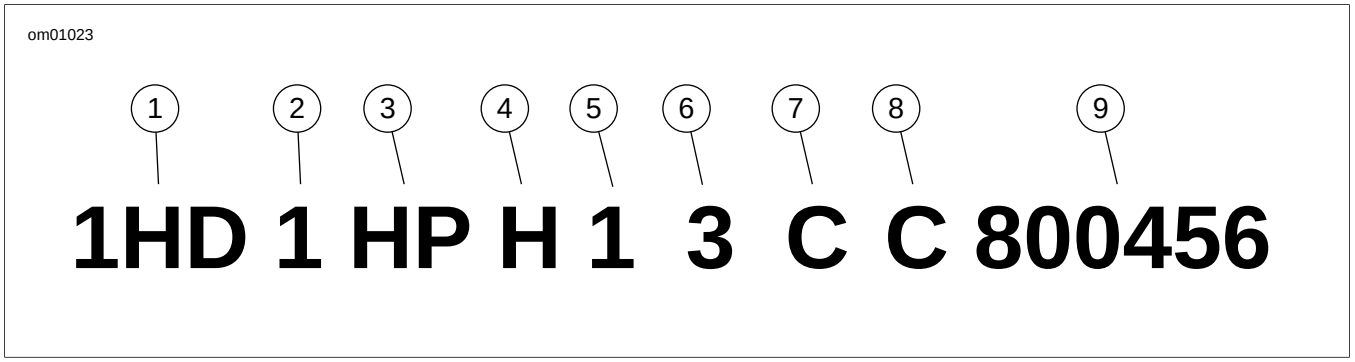


Figure 2-2. Typical Harley-Davidson VIN: 2012 VRSC Models

Table 2-6. Harley-Davidson VIN Breakdown: 2012 VRSC Models

POSITION	DESCRIPTION	POSSIBLE VALUES
1	World manufacturer identifier	1HD=Originally manufactured for sale **within** the United States 5HD=Originally manufactured for sale **outside** of the United States 932=Originally manufactured in and for sale only in Brazil market MEG=Originally manufactured in and for sale only in India market
2	Motorcycle type	1=Heavyweight motorcycle (901 cc and larger)
3	Model	See V.I.N. model table
4	Engine type	H=Revolution®, 1247 cm^3 liquid-cooled, fuel injected J=Revolution®, 1247 cm^3 liquid-cooled, fuel injected 105 HP HDI only

Table 2-6. Harley-Davidson VIN Breakdown: 2012 VRSC Models

POSITION	DESCRIPTION	POSSIBLE VALUES	
5	Introduction date/calibration	**Normal Introduction** 1=Domestic 3=California A=Canada C=HDI E=Japan G=Australia J=Brazil L=Asia Pacific N=India	**Mid-year or Special Introduction** 2, 4=Domestic 5, 6=California B=Canada D=HDI F=Japan H=Australia K=Brazil M=Asia Pacific P=India
6	V.I.N. check digit	Can be 0-9 or X	
7	Model year	C=2012	
8	Assembly plant	C=Kansas City, MO USA D=H-D Brazil-Manaus, Brazil (CKD) N=Haryana India (Bawal District Rewari)	
9	Sequential number	Varies	

Table 2-7. VIN Model Codes: 2012 VRSC Models

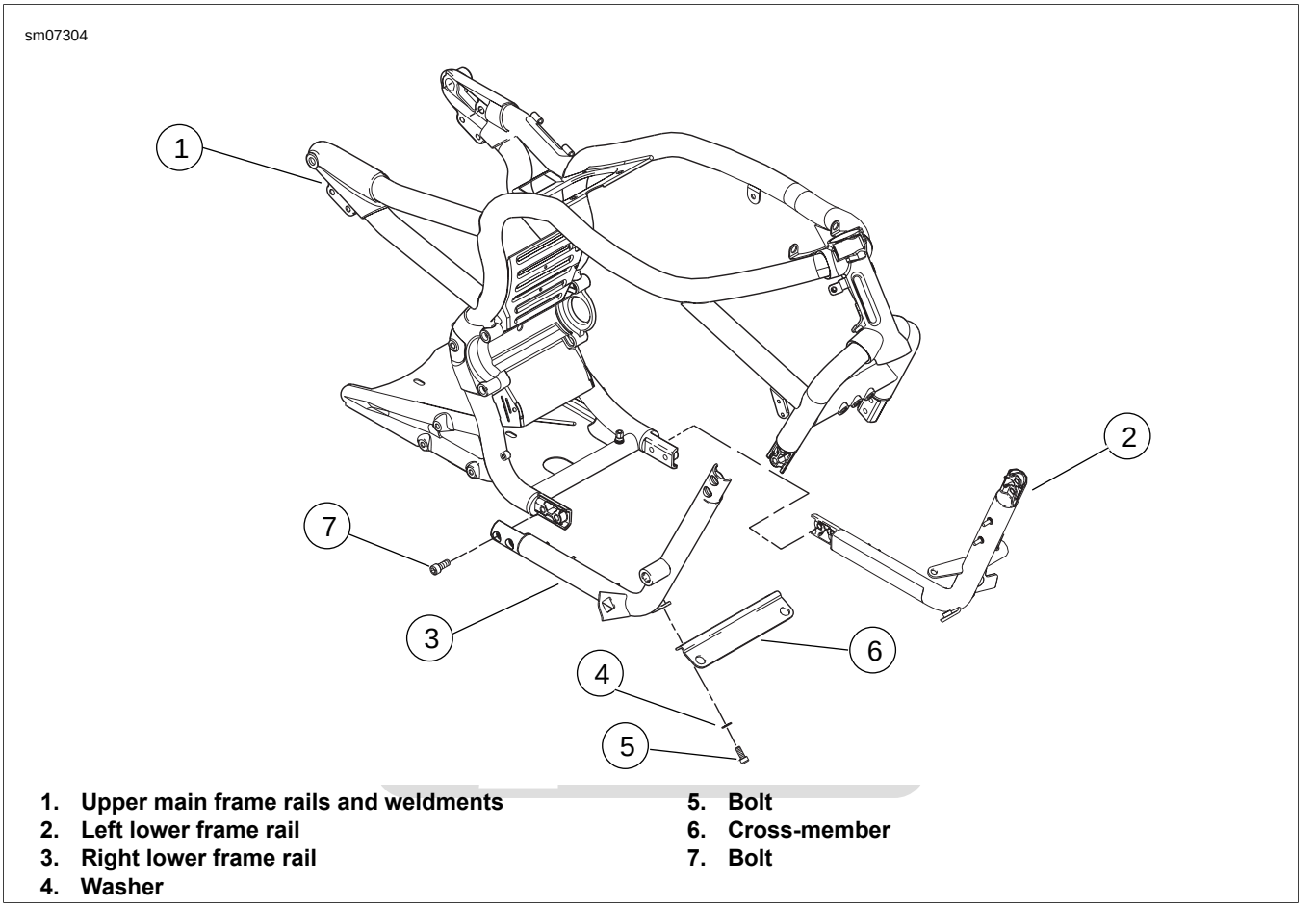
CODE	MODEL	CODE	MODEL
HH	VRSCDX Night Rod® Special VRSCDX ANV V-Rod® 10th Anniversary Edition	HP	VRSCF V-Rod Muscle™

DIGITAL TECHNICIAN® II HARLEY-DAVIDSON®

LOWER FRAME RAILS 2.4

GENERAL

The steel upper hydroformed main rails, joined with stamped sheet metal weldments for the steering head, seat, rear fork pivots, fuel tank shield, and rear fender, are bolted to left and right lower frame rails that complete the frame perimeter.



1. **Upper main frame rails and weldments**
2. **Left lower frame rail**
3. **Right lower frame rail**
4. **Washer**
5. **Bolt**
6. **Cross-member**
7. **Bolt**

Figure 2-3. Steel Perimeter Frame and Bolt-on Lower Frame Rails

REMOVAL

1. Support motorcycle under fuel tank frame weldment and/or lock wheels so that frame rails can be removed.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect negative battery cable.
5. See Figure 2-3. Remove two cross member bolts (5) and washers (4) and remove cross member. See 5.10 RADIATOR AND OIL COOLER.
6. Remove fluid line clips from right lower frame rail. See 2.14 CLUTCH FLUID LINE.
7. Remove rider footrests and controls. See 2.9 RIDER FOOTRESTS AND FOOT CONTROLS.
8. Remove rear brake master cylinder and reservoir. See 2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR.
9. Remove jiffy stand and rubber bumper from left lower frame rail. See 2.41 JIFFY STAND.
10. Remove engine mount stabilizer link from frame rail bracket. See 2.5 FRONT ENGINE MOUNT.

NOTE

Maintain stabilizer link length for installation. Do not loosen jamnuts on stabilizer link.

11. Remove bolts (7) holding on the right and left lower frame rails (2, 3). Remove the frame rails.

INSTALLATION

FASTENER	TORQUE VALUE	
Stabilizer to frame tab	34-41 Nm	25-30 ft-lbs
Cross member mounting bolts	20-26 Nm	15-19 ft-lbs
Lower frame rail bolts (initial torque)	61-75 Nm	45-55 ft-lbs
Lower frame rail bolts (final torque)	61-75 Nm	45-55 ft-lbs
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

1. See Figure 2-3. Install left and right lower frame rails (2, 3) and finger tighten mounting bolts (7).
2. Using clips, attach clutch fluid line to right lower frame rail. See 2.14 CLUTCH FLUID LINE.
3. Attach the engine mount stabilizer link to the frame tab. Tighten to 34-41 Nm (25-30 ft-lbs). See 2.5 FRONT ENGINE MOUNT.
4. Install cross member mounting bolts (5) and washers (4). Tighten to 20-26 Nm (15-19 ft-lbs). See 5.10 RADIATOR AND OIL COOLER.
5. Tighten lower frame rail bolts (7) to 61-75 Nm (45-55 ft-lbs). Loosen bolts 90 degrees and retighten to 61-75 Nm (45-55 ft-lbs).
6. Install jiffy stand and rubber bumper. See 2.41 JIFFY STAND.
7. Install rear brake master cylinder and reservoir. See 2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR.
8. Install footrests and controls. See 2.9 RIDER FOOTRESTS AND FOOT CONTROLS
9. Connect negative battery cable. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
10. Install air cleaner assembly.
11. Install main fuse and right side cover. See 7.6 MAIN FUSE.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FRONT ENGINE MOUNT 2.5

REPLACEMENT

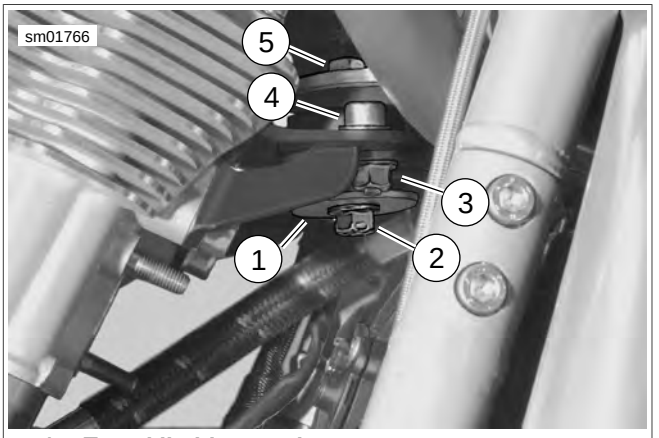
FASTENER	TORQUE VALUE	
Front engine mount bolts	34-41 Nm	25-30 ft-lbs
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

1. Support engine under the oil pan with a suitable lifting device.
2. Remove the right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect negative battery cable.
5. See Figure 2-4. Loosen and remove nut (2) and travel limiting washer (1) from center mounting bolt (5).
6. Loosen and remove nuts (3) from engine mount bolts (4).
7. By lifting up the center mounting bolt (5) slightly, the engine mount pivots down and out away from the fan shroud.
8. Install **new** engine mount and left and right engine mounting bolts (4).
9. Install travel limiting washer (1) and center mounting bolt nut (2).
10. Tighten all fasteners to 34-41 Nm (25-30 ft-lbs).
11. Connect negative battery cable. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
12. Install air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
13. Install main fuse and right side cover. See 7.6 MAIN FUSE.



1. **Travel limiting washer**
2. **Center mounting bolt nut**
3. **Engine mount bolt nut**
4. **Engine mount bolt and washer**
5. **Center mounting bolt**

Figure 2-4. Engine Mount (Exhaust Removed for Clarity)

FRONT ENGINE MOUNT ASSEMBLY 2.6

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect negative battery cable.
4. Remove radiator assembly as required. See 5.10 RADIATOR AND OIL COOLER.
5. See Figure 2-5. Loosen and remove double threaded studs (11) that hold front engine mount bracket (3) to frame.
6. Remove bolts (10) that hold front engine mount bracket (4) to engine and work assembly out of frame between two lower frame rails.

DISASSEMBLY AND ASSEMBLY

FASTENER	TORQUE VALUE	
Engine mount to bracket	34-41 Nm	25-30 ft-lbs

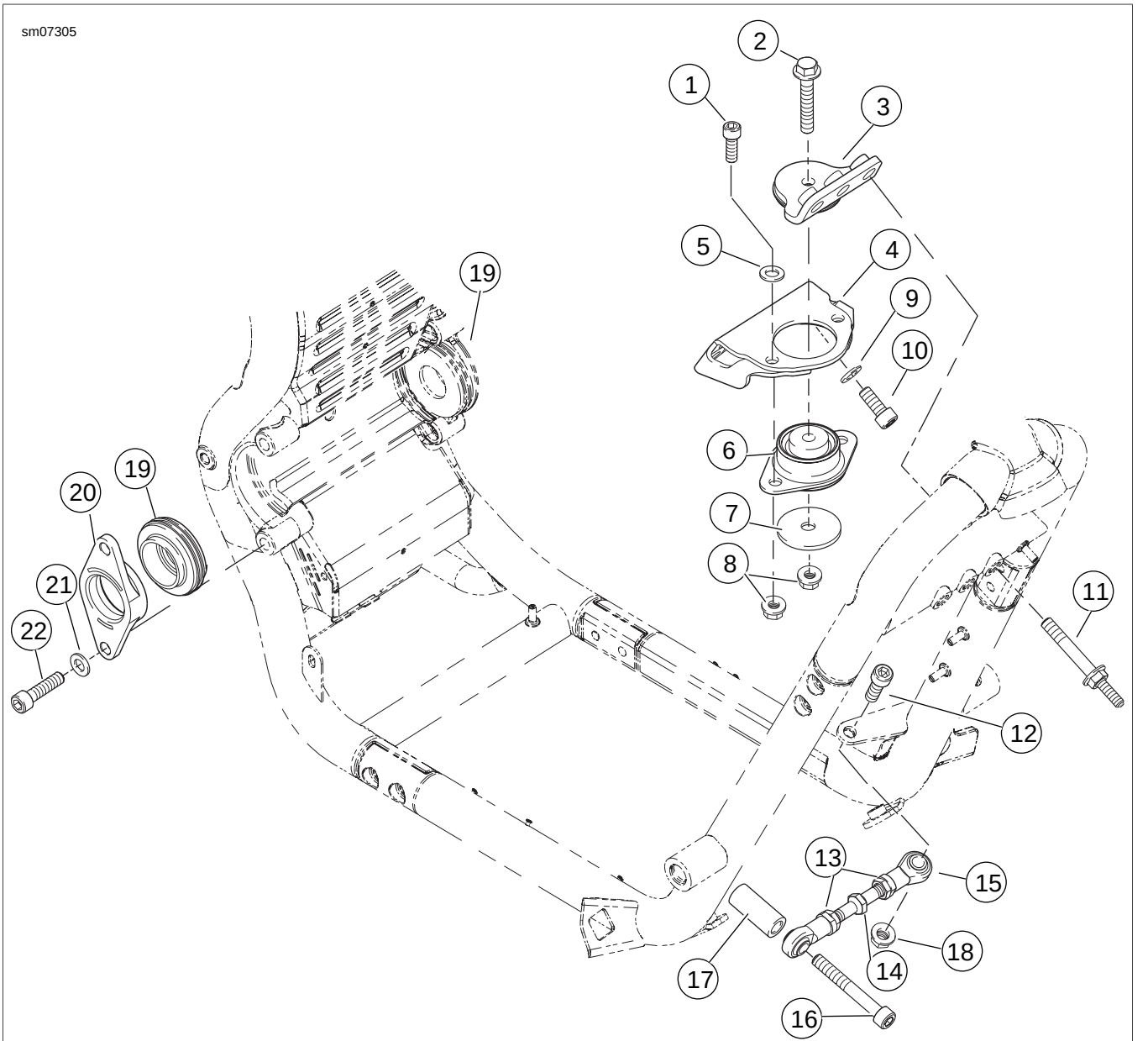
1. See Figure 2-5. Loosen and remove nut (8) from center mounting bolt (2) holding engine mount (6), travel limiting washer (7) and the two brackets (3, 4) together.
2. Remove two bolts (1) holding engine mount (6) to engine mount bracket (4). Remove engine mount (6).
3. Inspect for worn or damaged parts, replace as necessary.
4. Align engine mount bolt (2) through the frame bracket (4) and the engine mount (6) with the flange of the engine mount under the engine bracket and the large end up through the engine bracket. Slide on the travel limiting washer (7) and loosely install the flanged hex-nut (8).
5. Install and tighten fasteners (1), washers (5) and nuts (8) holding engine mount (6) to bracket to 34-41 Nm (25-30 ft-lbs).

INSTALLATION

FASTENER	TORQUE VALUE	
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs
Engine mount double threaded studs	34-41 Nm	25-30 ft-lbs
Center mounting bolt	34-41 Nm	25-30 ft-lbs
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

1. See Figure 2-5. Start, but do not tighten bolts (10) and washers (9) fastening engine mount bracket (4) to engine cylinder head.
2. Attach frame bracket to frame with double threaded studs.
3. Alternately tighten engine mount bolts (10) and the two threaded studs (11). Tighten the engine bolts (10) to 34-41 Nm (25-30 ft-lbs). Tighten the two threaded studs (11) to 34-41 Nm (25-30 ft-lbs).
4. Tighten center mounting bolt (2) and travel limiting washer to 34-41 Nm (25-30 ft-lbs).
5. Install radiator assembly. See 5.10 RADIATOR AND OIL COOLER.
6. Connect negative battery cable. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
7. Install air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
8. Install main fuse and right side cover. See 7.6 MAIN FUSE.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Bolt
2. Center mounting bolt
3. Bracket front engine mount - frame
4. Bracket front engine mount - engine
5. Washer
6. Front engine mount
7. Washer - travel limiting
8. Nut
9. Washer
10. Bolt
11. Double threaded stud
12. Bolt
13. Jam nut
14. Fixed nut
15. Stabilizer link
16. Bolt
17. Spacer
18. Nut
19. Rear engine mount
20. Bracket - rear engine mount
21. Washer
22. Fasteners

Figure 2-5. Engine Mounts (typical)

REAR ENGINE MOUNTS 2.7

REMOVAL

1. Support motorcycle under fuel tank frame weldment and lock the front wheel so that the engine can be removed.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect negative battery cable.
5. Remove rear fork assembly. See 2.37 REAR FORK.
6. See Figure 2-5. Remove fasteners (22) holding right rear engine mount bracket (20) to the frame.
7. Remove rear engine mounts (19).

INSTALLATION

FASTENER	TORQUE VALUE	
Rear engine mount fasteners	34-41 Nm	25-30 ft-lbs
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

1. See Figure 2-5. Install left rear engine mount (19) in left side frame weldment.
2. Install rear engine mount bracket (20) to frame with fasteners (22) and washers (21). Tighten fasteners to 34-41 Nm (25-30 ft-lbs).
3. Install rear fork assembly. See 2.37 REAR FORK.
4. Connect negative battery cable. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
5. Install air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
6. Install main fuse and right side cover. See 7.6 MAIN FUSE.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

ENGINE REPLACEMENT 2.8

GENERAL

Removal and replacement of the engine may be required for either replacement engines or for engine overhaul.

REMOVAL

PART NUMBER	TOOL NAME
HD-45317	ENGINE ASSEMBLY SUPPORT FIXTURE

FASTENER	TORQUE VALUE	
Oil drain plug	35 Nm	25 ft-lbs
Front engine drain plug	9.7 Nm	86 **in-lbs**

1. On a table lift, position a scissors jack under the fuel tank.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

2. Purge fuel supply line of high pressure gasoline.
 a. Disconnect fuel module connector [86] from top plate.
 b. In neutral, start engine and allow engine to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
3. Place a suitable container under engine, loosen oil drain plug and drain oil.
4. Install and tighten oil drain plug to 35 Nm (25 ft-lbs).
 a. If replacing engine, leave oil filter threaded into its mounting plate.
 b. For engine overhaul, remove oil filter as necessary.

NOTE

Dispose of oil in accordance with local regulations.

5. Remove right side cover and main fuse. See 7.6 MAIN FUSE.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

6. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
7. Disconnect negative and positive battery cables from battery. See 1.24 BATTERY MAINTENANCE.
8. At the fuel rail, disconnect pressure fuel line and return fuel line by compressing tabs with thumb and first finger.
9. See Figure 2-7. Disconnect copper L-bracket (1) with negative battery cable from front cylinder head.
10. Remove GRND2, install fastener.
11. Remove GRND1, install fastener.
12. Separate wiring connectors from horn. Unbolt and remove horn from rubber grommet on frame. See 7.26 HORN.
13. Separate:
 a. Front (2) and rear coil connectors [83F, 83R].
 b. Main engine connector [145] (7).
 c. Throttle position sensor [88] (4).
 d. Idle air control actuator [87] (5).
 e. Coolant temperature sensor [90].
14. Pull the purge solenoid hose (6) off throttle body (California models only).
15. Perform throttle body procedure:
 a. If replacing engine, loosen throttle cable adjuster jamnuts. Turn throttle cable adjuster until cable is as short as possible. Remove throttle cable housings from guides at the throttle body and remove cable barrels from throttle cam.
 b. See Figure 2-6. For engine overhaul, loosen clamps at each intake and lift throttle body straight up. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. Cover intake openings to prevent objects from falling into intake bore.
16. Remove exhaust system. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF.
17. Remove left and right side radiator covers. See 5.10 RADIATOR AND OIL COOLER.
18. Separate the following items:
 a. Crank position sensor connector [79].
 b. Top and bottom cooling fan connectors [97T] [97B].

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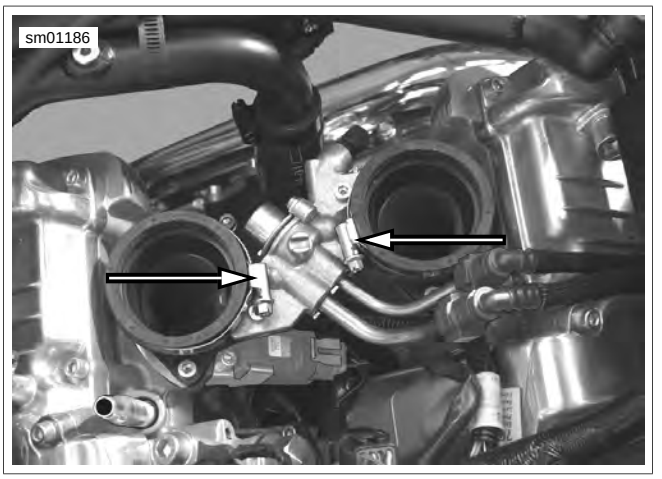


Figure 2-6. Intake Clamps, Throttle Body Removed (typical)

NOTE

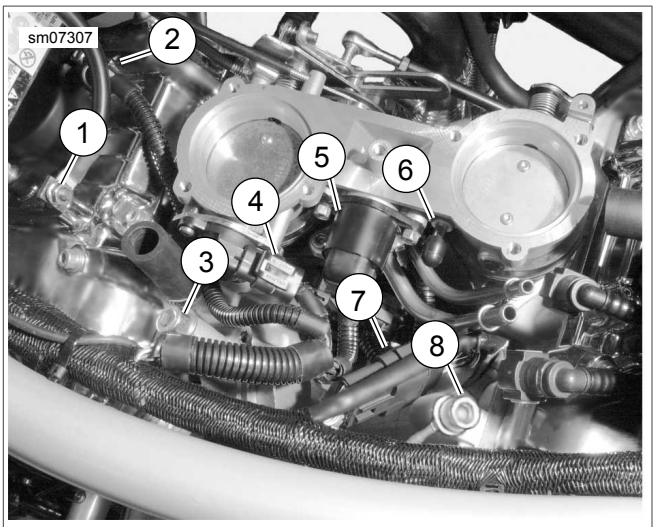
Note the position of the clamps for assembly.

19. See Figure 2-8. Cover front fender with a shop towel or protective cover. On right side, pull rear brake fluid reservoir from radiator cover.
20. Remove two fasteners and washers (2) on each side of radiator cover and remove radiator cover.
21. Remove connectors [47] and [77] from the voltage regulator.
22. Place a suitable container under radiator and open pressure cap.
23. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container and allow coolant to drain from the radiator.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

24. See Figure 2-9. Place a suitable container under engine and remove front engine coolant drain plug. Allow remaining coolant to drain from engine.
25. Install front engine drain plug and tighten to 9.7 Nm (86 **in-lbs**).
26. Hand tighten radiator drain plug.
27. Loosen worm drive clamps on radiator hoses.



1. **Negative battery cable copper L-bracket**
2. **Front cylinder coil connector**
3. **GND 2**
4. **Throttle position sensor connector [88]**
5. **Idle air control actuator connector [87]**
6. **Purge solenoid fitting**
7. **Main engine connector [145]**
8. **GND 1**

Figure 2-7. Wiring Connections (typical)

28. Loosen and remove cross member fasteners holding the bottom of the radiator/oil cooler assembly on both sides.
29. Pull radiator/oil cooler assembly forward at the bottom. Separate oil lines from crankcase (oil in) and oil filter (oil out) fittings. See 5.9 OIL LINE FITTINGS.
30. Remove radiator/oil cooler assembly. See 5.10 RADIATOR AND OIL COOLER.
31. Remove engine coolant pipes. See 5.7 COOLANT PIPES AND HOSES.

NOTE

Dispose of coolant in accordance with local regulations.

32. Remove drive sprocket cover.

NOTE

Remove debris deflector/belt guard, if required, for clearance. See 2.35 BELT GUARD AND DEBRIS DEFLECTOR.

33. See Figure 2-10. Loosen retaining bolts holding drive sprocket to sprocket mounting flange.

NOTE

Do not remove the output shaft flange nut.

34. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
35. See Figure 2-10. Remove retaining bolts from drive sprocket. Remove sprocket from mounting flange. Discard bolts.
36. Remove secondary clutch actuator cover and secondary clutch actuator. See 2.15 SECONDARY CLUTCH ACTUATOR.

NOTE

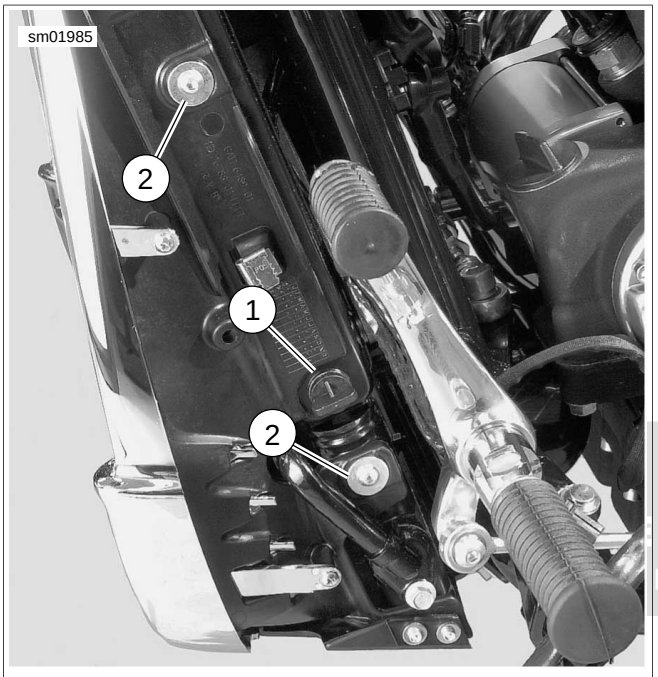
It is not necessary to loosen flare nut or to remove clutch fluid line from the secondary clutch actuator.

37. Remove solenoid cable protective boot from starter post and loosen and remove nut. Remove solenoid cable terminal ring. See 7.11 STARTER SOLENOID.

38. Remove nuts holding starter solenoid to frame and pull solenoid off of frame studs. See 7.11 STARTER SOLENOID.

NOTE

To avoid strain on solenoid green and black wire leads, locate connector under left side cover and separate connector halves.



1. **Drain plug**
2. **Cover fastener and washer**

Figure 2-8. Radiator Cover Left Side (typical)

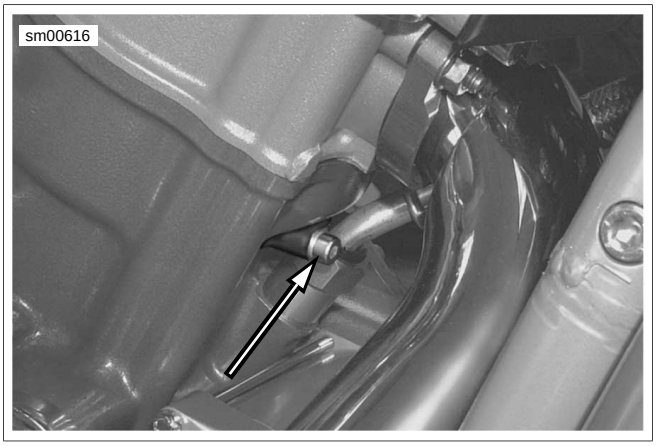


Figure 2-9. Front Engine Coolant Drain Plug

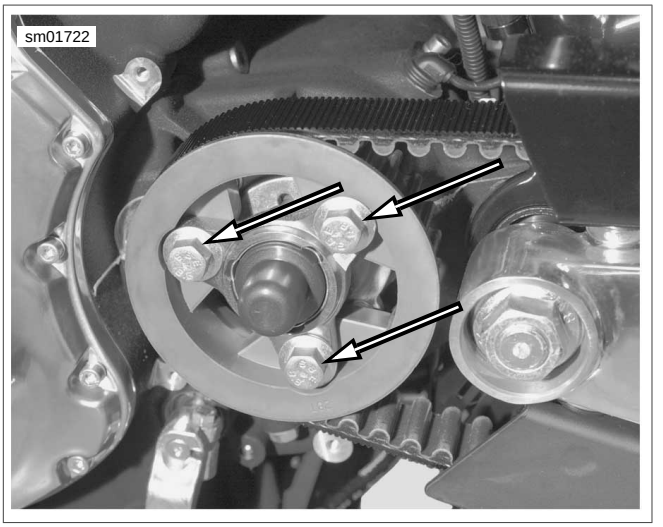


Figure 2-10. Drive Sprocket Retaining Bolts

39. See Figure 2-11. Raise motorcycle and position ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317) under engine.
 a. Align the two hex socket-head bolts (2) at rear of fixture with mounting screw detents at bottom rear of oil pan.
 b. Align the two separated hex head bolts (1) on each side of front of fixture with corresponding mounting screw detents on sides of oil pan.
 c. Using a suitable lifting device, lower motorcycle until engine oil pan screw detents rest on hex socket-head bolts.
40. Remove nut and travel limiting washer from center engine mount bolt. Remove center mounting bolt.
41. Remove fasteners holding front engine mount bracket to engine.
42. Remove upper radiator studs securing frame engine mount bracket to frame. Pull front engine mount assembly forward through frame rails.
43. Remove stabilizer link bolt from frame bracket. See 2.5 FRONT ENGINE MOUNT.

NOTE

Maintain stabilizer link length for installation. Do not loosen jamnuts on stabilizer link.

44. Remove rear fork pivot nut and slide out pivot shaft.
45. Remove left side rear engine mount bracket. See 2.7 REAR ENGINE MOUNTS.
46. Remove shifter linkage from engine shifter arm on transmission.
47. Remove engine ground cable from frame.
48. Remove lower left frame rail with stabilizer link attached. See 2.4 LOWER FRAME RAILS.

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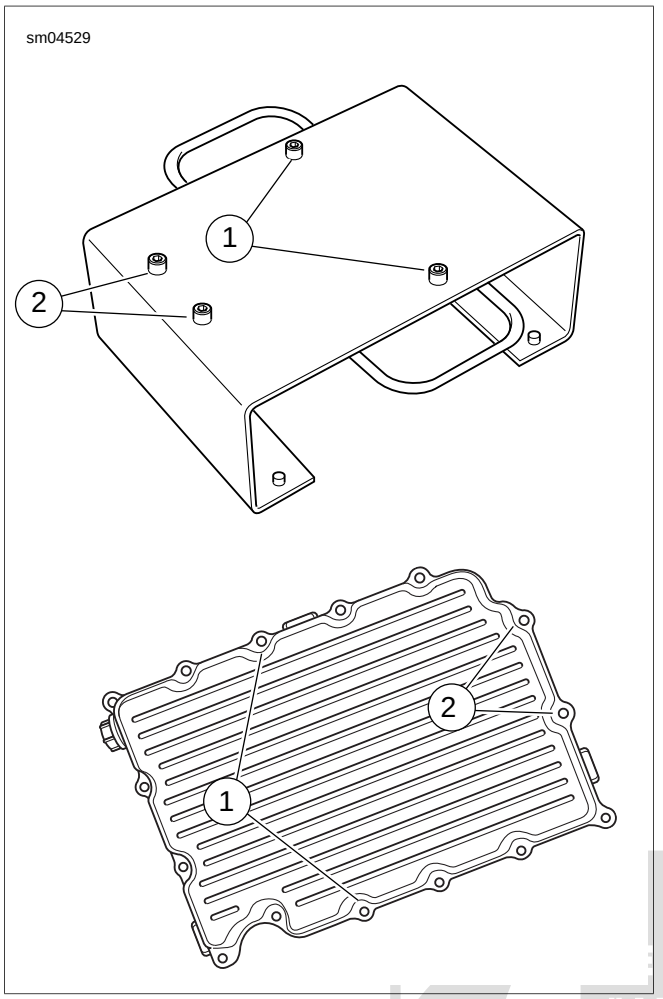


Figure 2-11. Engine Assembly Support Fixture Alignment

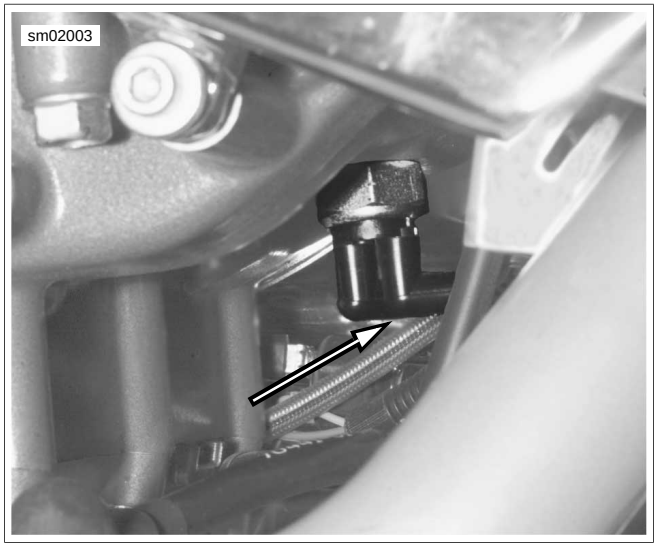


Figure 2-12. Neutral Light Sender Connectors [131]

NOTE

To move engine on support fixture, support engine and pull on fixture handles.

49. With engine resting in ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317), gently pull on handles to work engine partially out of left side of frame.
50. See Figure 2-12. Remove connectors to neutral switch [131] under drive sprocket.

NOTE

The neutral switch stays in the engine.

51. See Figure 2-13. Remove connectors from stop lamp switch [121].
52. Pull the coolant overflow hose and purge solenoid hose (California models only) through top of the cavity in engine cases.
53. See Figure 2-14. Disconnect vehicle speed sensor wire from connector [65] at vehicle speed sensor.
54. Using fixture handles, pull engine out of frame onto left side extension.
55. See Figure 2-15. Engine may be secured with straps for hoisting.
56. Replace or rebuild engine.
 a. If replacing engine with a new engine, proceed to 2.8 ENGINE REPLACEMENT, Installation.
 b. If rebuilding engine, mount engine on stand and proceed to 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING.

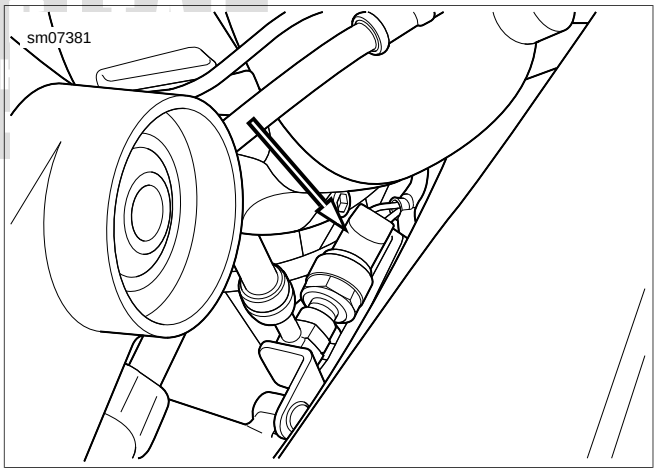


Figure 2-13. Stoplamp Switch Connectors (non-ABS models)

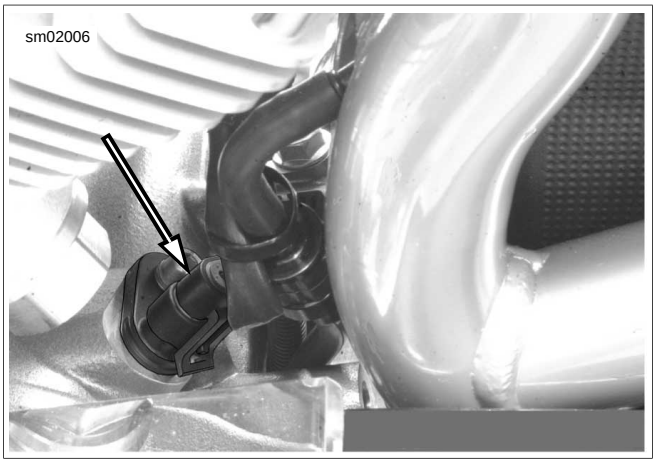


Figure 2-14. Vehicle Speed Sensor Connector [65]

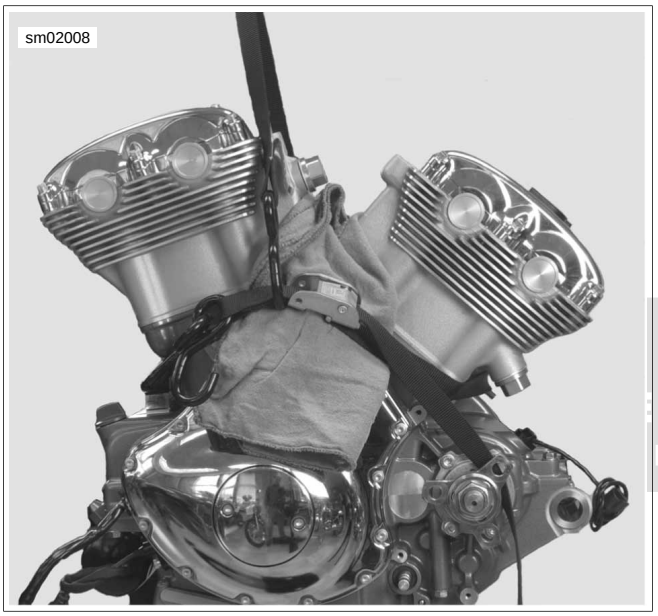


Figure 2-15. Engine Strapped for Hoisting

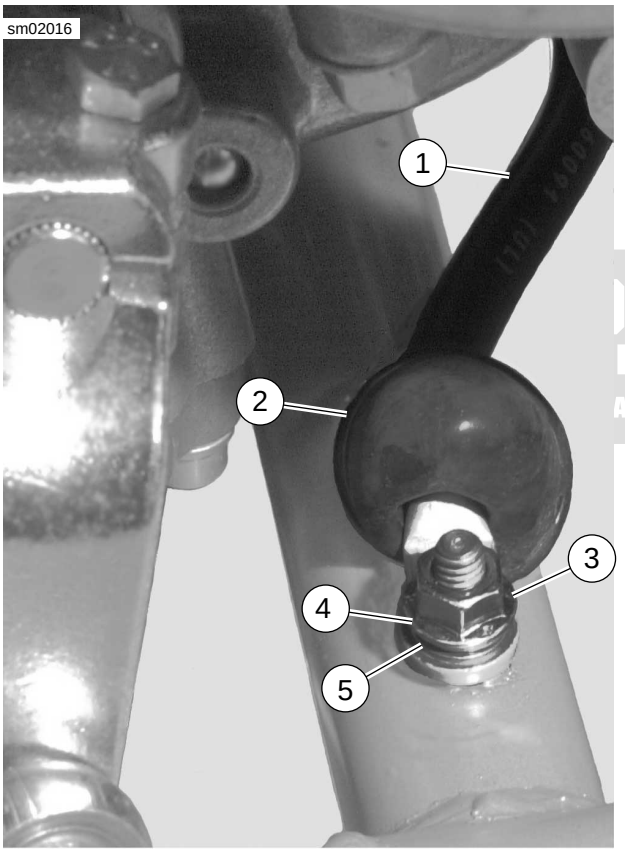
INSTALLATION

PART NUMBER	TOOL NAME
HD-45317	ENGINE ASSEMBLY SUPPORT FIXTURE

FASTENER	TORQUE VALUE	
Ground cable terminal ring nut bolt	6-10 Nm	53-88 **in-lbs**
Pivot shaft nut	61-75 Nm	45-55 ft-lbs
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs
Engine mount double-threaded studs	34-41 Nm	25-30 ft-lbs
Lower frame rail bolts	61-75 Nm	45-55 ft-lbs
Engine crankcase end of stabilizer link	34-41 Nm	25-30 ft-lbs
Shifter arm clamp bolt	14-16 Nm	132-144 **in-lbs**
Shifter linkage to shifter arm bolt	9-15 Nm	80-133 **in-lbs**
Solenoid cable terminal ring	6-10 Nm	53-88 **in-lbs**
Starter solenoid mounting	6-10 Nm	53-88 **in-lbs**
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs
Rear axle nut	190-203 Nm	140-150 ft-lbs
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**
Cooling system, cross member fasteners	20-26 Nm	15-19 ft-lbs
Cooling system, top mounting flange nuts	19-27 Nm	15-20 ft-lbs
Cooling system, pipe clamp	6.5 Nm	57 **in-lbs**
Cooling system, pipe connecting clamp	6-10 Nm	53-88 **in-lbs**
Cooling system, P-clamp	6-10 Nm	53-88 **in-lbs**
Cooling system, hose worm drive clamps	3-4 Nm	27-35 **in-lbs**
Throttle body clamp fasteners	1.25 Nm	11 **in-lbs**
Coolant air bleed plug	9-11 Nm	80-97 **in-lbs**
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

1. Verify that engine wiring harness is connected to:
 a. Manifold air pressure sensor [80].
 b. Intake air temperature sensor [89].
 c. Coolant temperature sensor [90].
 d. Oil pressure sending unit [120].
 e. Injector connectors [84, 85].
2. Check oil filter tightness. See 1.6 ENGINE OIL AND FILTER.

3. Install rear engine mount and bracket in right side frame weldment. Pull engine partially into frame capturing left rear engine mount.
4. With engine oil pan screw detents resting on hex socket-head bolts of the ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317), pull engine into frame with fixture handles.
5. Thread coolant overflow hose and purge solenoid hose (California models only) through cavity in engine cases.
6. See Figure 2-13. Install stop lamp switch connectors [121].
7. See Figure 2-16. Fasten ground cable (1) terminal ring (4) with washer (5) to frame. Tighten to 6-10 Nm (53-88 **in-lbs**) and install rubber boot.
8. See Figure 2-12.Install neutral switch connectors [131].
9. See Figure 2-14. Connect vehicle speed sensor [65] to wiring harness.



1. **Ground cable**
2. **Boot (pulled back from nut)**
3. **Nut**
4. **Terminal ring**
5. **Washer**

Figure 2-16. Ground Cable Installation

NOTE

The left rear fork pivot shaft spacer is inserted into the engine mount. Verify that the pivot shaft spacer is in position before installing the pivot shaft.

10. Raise or lower frame with scissor jack to align pivot shaft bores of rear fork to rear engine mounts and engine case mounting bosses. Apply ANTI-SEIZE LUBRICANT and slide in rear fork pivot shaft.
11. Apply LOCTITE 243 MEDIUM STRENGTH THREADLOCKER AND SEALANT (blue) to threads of pivot shaft nut.
12. Install upper engine mounting bracket to engine with fasteners and engine mounting bracket to frame with double threaded studs.
13. Install left frame rail with stabilizer link.
14. Assemble spacer and stabilizer link and thread into crankcase.
15. Tighten fasteners in following order:
 a. Pivot shaft nut to 61-75 Nm (45-55 ft-lbs).
 b. Rear engine mount bracket fasteners (including stabilizer link fasteners) to 34-41 Nm (25-30 ft-lbs).
 c. Front engine mount fasteners to 34-41 Nm (25-30 ft-lbs).
 d. Lower frame rail fasteners to 61-75 Nm (45-55 ft-lbs).
 e. Engine crankcase end of stabilizer link to 34-41 Nm (25-30 ft-lbs).
16. See Figure 2-17. Install shifter arm perpendicular to frame rail for correct operation. Tighten clamp bolt to 14-16 Nm (132-144 **in-lbs**).
17. If removed, attach shifter linkage to shifter arm and tighten to 9-15 Nm (80-133 **in-lbs**).
18. Install solenoid cable terminal ring to starter post.
19. Tighten solenoid fasteners to the following torques:
 a. Solenoid cable terminal ring to starter post to 6-10 Nm (53-88 **in-lbs**).
 b. Starter solenoid to frame posts to 6-10 Nm (53-88 **in-lbs**).
 c. Install secondary clutch actuator onto clutch cover.
20. Install exhaust system.
21. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
22. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
23. Route drive belt over wheel sprocket and drive sprocket.
24. If removed, install and belt guard and debris deflector. See 2.35 BELT GUARD AND DEBRIS DEFLECTOR.
25. Adjust drive belt. See 1.10 DRIVE BELT AND SPROCKETS.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling and can cause loss of control, which could result in death or serious injury. (00285b)

26. Tighten axle nut to 190-203 Nm (140-150 ft-lbs) and install snap ring.
27. Install belt drive sprocket cover. Tighten cover fasteners to 6-10 Nm (53-88 **in-lbs**).
28. Install engine coolant pipes and hoses. Fasten P-clamp to cylinder head, pipe clamp, and worm drive clamps to both coolant pipe hoses. See 5.7 COOLANT PIPES AND HOSES.

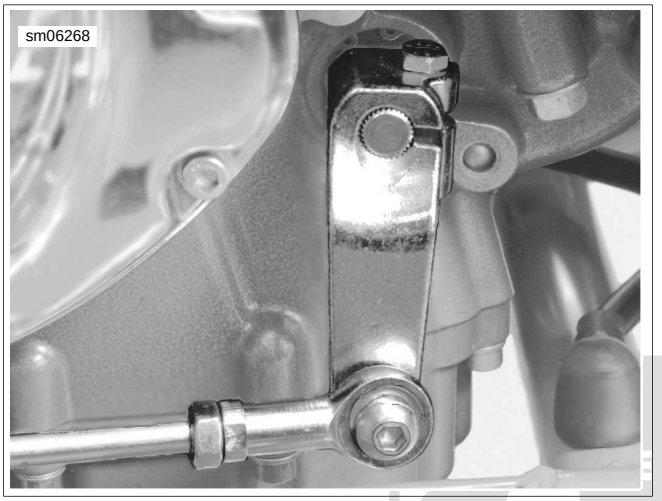


Figure 2-17. Shifter Arm Perpendicular to Frame Rail

29. Fit radiator/oil cooler assembly to top mounting studs. Fit coolant out and in hoses to radiator beaded pipes. See 5.10 RADIATOR AND OIL COOLER.
30. Install oil line quick connects to crankcase and oil filter mount oil fittings. See 5.9 OIL LINE FITTINGS.
31. Push radiator/oil cooler assembly mounting pins and grommets into cross member. Thread cross member mounting bolts into frame.
32. Tighten cooling system fasteners:
 a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
 b. Top mounting flange nuts to 19-27 Nm (15-20 ft-lbs).
 c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
 d. Pipe connecting clamp to 6-10 Nm (53-88 **in-lbs**).
 e. P-clamp to 6-10 Nm (53-88 **in-lbs**).
 f. Hose worm drive clamps to 3-4 Nm (27-35 **in-lbs**).
33. Install clutch actuator cover.
34. Install radiator cover. See 5.10 RADIATOR AND OIL COOLER.
35. Connect:
 a. Crank position sensor connector [79].
 b. Top and bottom cooling fan connectors [97T] [97B].
36. Push rear brake fluid reservoir onto radiator cover and install both lower radiator trim covers. See 5.10 RADIATOR AND OIL COOLER.
37. Install throttle body/cables:
 a. For replacement engines: Install original throttle body assembly, insert throttle cable barrels into throttle cam, route cable around throttle cam and insert cable housing in cable guides. Adjust cables. See 1.11 THROTTLE CABLES.
 b. For engine overhaul: Install throttle body and tighten clamps to 1.25 Nm (11 **in-lbs**).
38. Connect:
 a. Front and rear coils [83F] [83R].
 b. Main engine harness [145].
 c. Throttle position sensor [88].
 d. Idle speed control actuator [87].
 e. Regulator ground.
39. Install horn to rubber grommet and bracket on engine. Connect horn wire to main harness. See 7.26 HORN.
40. See Figure 2-7. Connect GND 2 (3), GND 1 (8) and horn ground wire to rear engine cylinder head.
41. Connect negative battery copper L-bracket and cable to front cylinder head.
42. Fill engine with oil. See 1.6 ENGINE OIL AND FILTER.
43. Open radiator air bleed plug and fill cooling system with Genuine Harley-Davidson Extended Life Antifreeze and Coolant through coolant pressure cap. See 5.4 ENGINE COOLANT.
44. Tighten radiator air bleed plug to 9-11 Nm (80-97 **in-lbs**).

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

45. Connect positive battery cable to battery, cover with boot and then connect negative battery cable to battery. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
46. Install main fuse.
47. With the fuel module [86] disconnected, use the starter to turn the engine over to prime the engine with oil. The engine oil pressure indicator lamp should extinguish as the engine is cranked. See 3.6 OIL PRESSURE.
48. Install air filter components. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
49. Connect fuel module connector [86]. Run to operating temperature.

50. Check coolant and oil levels.
51. Install right side cover.
52. Test ride motorcycle and adjust as required.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

RIDER FOOTRESTS AND FOOT CONTROLS 2.9

RIDER FOOTRESTS

FASTENER	TORQUE VALUE	
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs
Shift linkage fastener	9-15 Nm	80-133 **in-lbs**

Removal

1. See Figure 2-18. Remove retaining ring (1) from clevis pin (7) holding footrest (3) to clevis (6). Remove clevis pin, footrest, and spring washer (5). Repeat on opposite side.

NOTES

- *Shift lever toe peg is threaded into shift lever. Remove and replace as required.*
- *Wear pegs (2) are threaded into footrests. Remove and replace as required.*

2. With motorcycle in neutral, remove fastener from shift linkage to shift lever (10).
3. Remove fastener (4) holding left side clevis to frame. Remove left pivot shaft (9) and foot shift lever.
4. Remove brake pedal (8) from rear brake master cylinder. See 2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR
5. Remove fastener holding right side clevis to frame. Remove right pivot shaft and brake pedal.

Installation

NOTE

See Figure 2-18. When installing pivot shafts (9), be sure flats on shaft line up with mating parts.

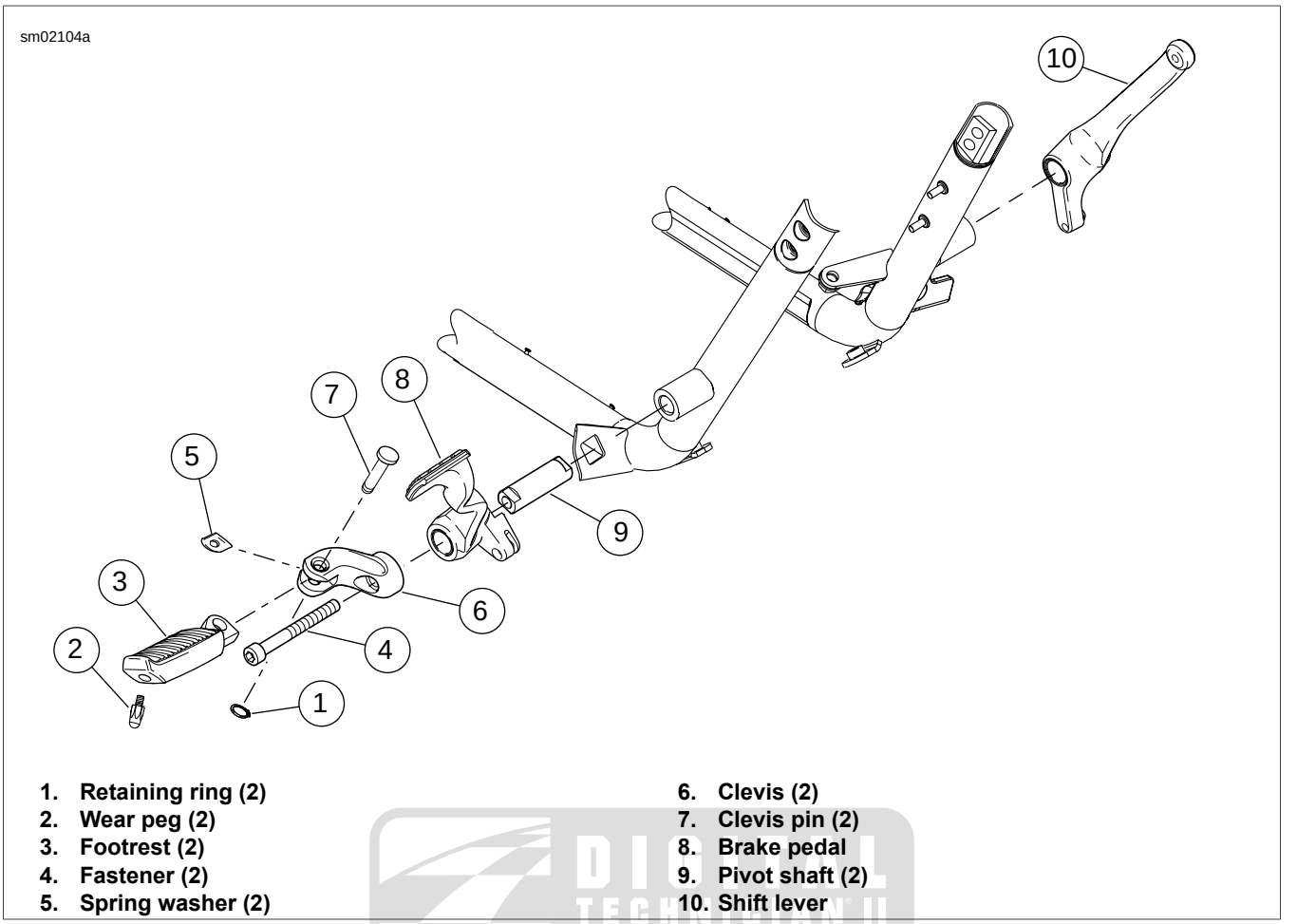
1. Apply LOCTITE 243 MEDIUM STRENGTH THREAD-LOCKER AND SEALANT (blue) to clevis fasteners (4)
2. Install right side pivot shaft, brake pedal (8), clevis (6) and fastener. Tighten fastener to 61-75 Nm (45-55 ft-lbs).
3. Install brake pedal to rear brake master cylinder. See 2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR
4. Install left side pivot shaft, shift lever (10), clevis (6) and fastener. Tighten fastener to 61-75 Nm (45-55 ft-lbs).
5. Install fastener holding shift linkage to foot shift lever. Tighten fastener to 9-15 Nm (80-133 **in-lbs**).

⚠WARNING

Footrests must fold up and toward rear of motorcycle if struck. Failure to set footrests to fold up and back could result in death or serious injury. (00366a)

6. Position footrest (3) to fold upwards on contact with ground.
7. Install clevis pin (7) through clevis (6), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1). Repeat on opposite side.

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1. Retaining ring (2)
2. Wear peg (2)
3. Footrest (2)
4. Fastener (2)
5. Spring washer (2)
6. Clevis (2)
7. Clevis pin (2)
8. Brake pedal
9. Pivot shaft (2)
10. Shift lever

Figure 2-18. Rider Footrests

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

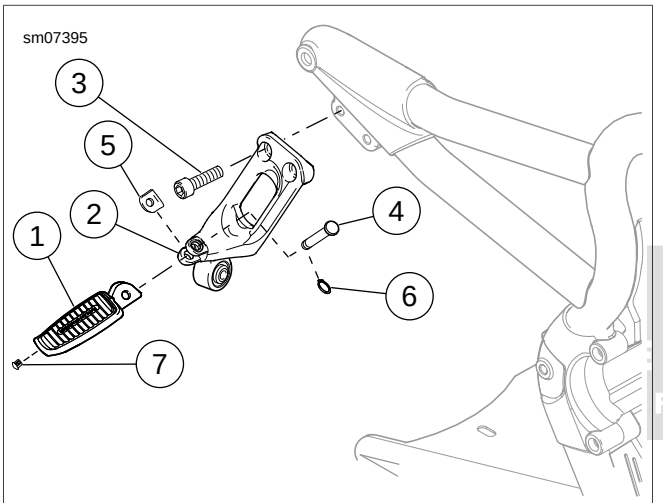
PASSENGER FOOTRESTS 2.10

PASSENGER FOOTRESTS: ALL EXCEPT VRSCF

FASTENER	TORQUE VALUE	
Footrest bracket socket head capscrews	55-70 Nm	40-52 ft-lbs

Removal

1. See Figure 2-19. Remove retaining clip (6) and spring washer (5) from clevis pin (4). holding footrest (1). Remove clevis pin, and footrest from footrest bracket (2).
2. Remove two socket head capscrews (3) from footrest bracket (2). Remove footrest bracket.
3. Repeat for opposite side passenger footrest assembly.



1. **Footrest**
2. **Footrest bracket**
3. **Socket head capscrews (2)**
4. **Clevis pin**
5. **Spring washer**
6. **Retaining clip**
7. **Plug (2)**

Figure 2-19. Passenger Footrests

Installation

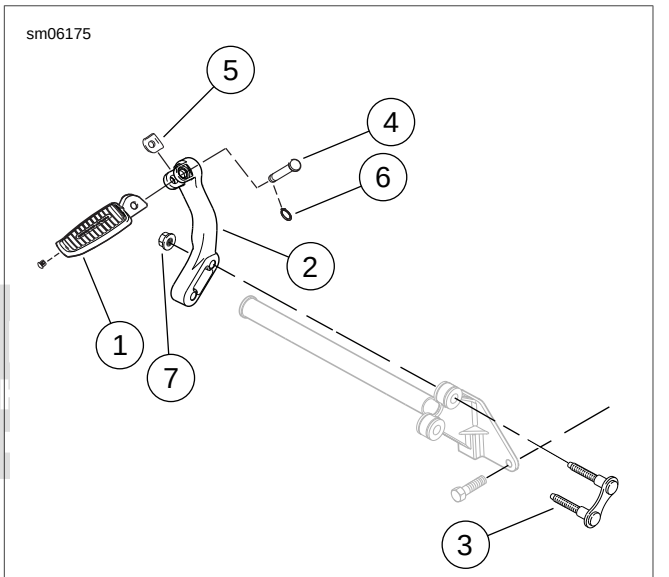
1. See Figure 2-19. Mount the footrest bracket (2) to frame. Install and tighten socket head capscrews (3) to 55-70 Nm (40-52 ft-lbs).
2. Install footrest (1) to footrest bracket and hold in upward position.
3. Install clevis pin (4) through footrest bracket (2), install spring washer (5) and secure with a retaining clip (6).
4. Repeat for opposite side.

PASSENGER FOOTRESTS: VRSCF

FASTENER	TORQUE VALUE	
Footrest bracket/stud plate nuts	19-27 Nm	14-20 ft-lbs

Removal

1. See Figure 2-20. Remove retaining clip (6) and spring washer (5) from clevis pin (4). holding footrest (1), remove clevis pin, and footrest from footrest bracket (2).
2. Remove two nuts (7) from footrest bracket (2). Remove footrest bracket.
3. Repeat for opposite side passenger footrest assembly.



1. **Footrest**
2. **Footrest bracket**
3. **Stud plate (2)**
4. **Clevis pin**
5. **Spring washer**
6. **Retaining clip**
7. **Nut (4)**

Figure 2-20. Passenger Footrests (VRSCF)

Installation

1. See Figure 2-20. Mount the footrest bracket (2) to exhaust support using the stud plate (3). Install and tighten nuts (7) to 19-27 Nm (14-20 ft-lbs).
2. Install footrest (1) to footrest bracket and hold in upward position.
3. Install clevis pin (4) through footrest bracket (2), install spring washer (5) and secure with a **new** retaining clip (6).
4. Repeat for opposite side.

THROTTLE CABLES 2.11

REMOVAL/DISASSEMBLY

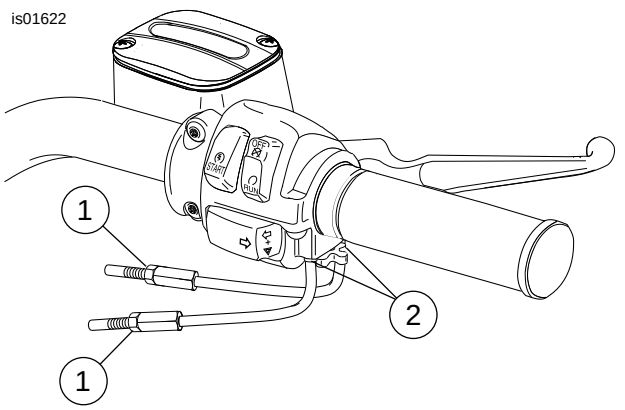
1. See Figure 2-21. Loosen cable adjuster jam nuts (1). Screw throttle cable adjuster until it is as short as possible.
2. Remove screws that hold handlebar housing together to separate the upper and lower housings.
3. Remove cables from throttle grip and lower housing.
4. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
5. Remove throttle cable housings from guides at throttle body and remove cable barrels from throttle cam.
6. See Figure 2-22. Pull cables from housing by placing a drop of oil on retaining ring that holds cable in housing, then firmly pull bent tubing portion of cable out of housing using a rocking motion.

CLEANING AND INSPECTION

⚠WARNING

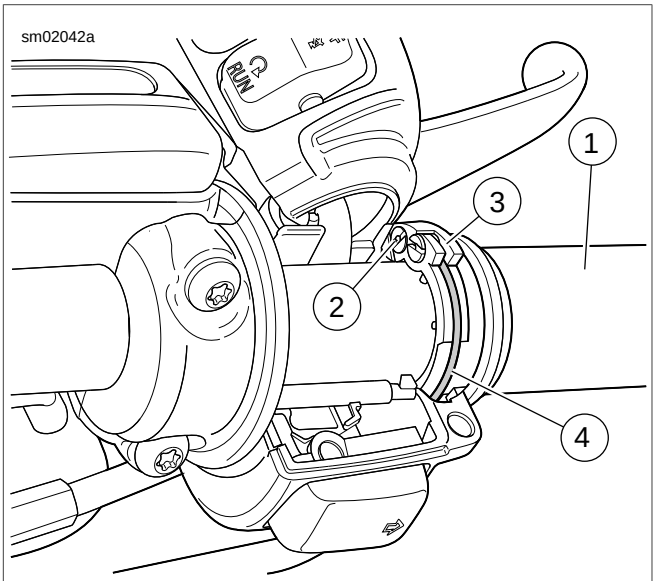
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

1. Wash all components in non-flammable cleaning solvent. Blow parts dry with low pressure compressed air.
2. Replace control cables if frayed, kinked or bent.
3. Put one or two drops of HARLEY LUBE into housing of each cable.



1. **Adjuster jam nut (2)**
2. **Insert (2)**

Figure 2-21. Handlebar Throttle Control



1. **Throttle grip**
2. **Ferrule**
3. **Groove**
4. **Idle cable (gold insert, rear hole)**

Figure 2-22. Throttle Cable Attachment

ASSEMBLY AND INSTALLATION

FASTENER	TORQUE VALUE	
Throttle housing screws	4-5 Nm	35-45 **in-lbs**

1. Apply a light coating of graphite to handlebar and inside surface of housings.
2. See Figure 2-22. Attach control cable assemblies to lower housing.
 a. Push silver insert of the cable housing into hole in front of tension adjuster screw. Snap in retaining ring.
 b. Push gold insert of idle cable housing into hole at rear of tension adjuster screw. Snap in retaining ring.
 c. Install adjusting screw, spring and friction pad in lower housing if they were removed.
3. Position throttle grip on the handlebar. Place lower housing on throttle grip.
4. Fit ferrules (2) over cable balls. Slide ferrules into throttle notches and rotate so cables fit grooves (3) in throttle grip.
5. Fasten upper housing to lower housing using two screws. Tighten to 4-5 Nm (35-45 **in-lbs**).
6. See Figure 2-23. Route throttle cables over upper fork clamp and through right side cover opening along side battery to throttle body.

⚠WARNING

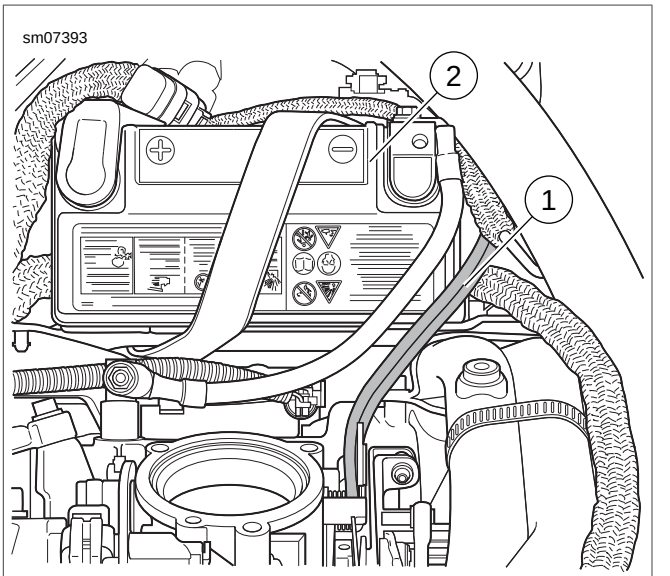
Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. (00494c)

7. Insert throttle cable barrels on throttle cam and fit cables into guides.

⚠WARNING

Do not tighten throttle friction adjustment screw to the point where the engine will not return to idle automatically. Over-tightening can lead to loss of vehicle control, which could result in death or serious injury. (00031b)

8. Adjust cables for correct throttle opening and closing. See 1.11 THROTTLE CABLES.
9. Install air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Throttle cables**
2. **Battery**

Figure 2-23. Throttle Cable Routing

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CLUTCH MASTER CYLINDER AND RESERVOIR 2.12

GENERAL

The clutch is hydraulically actuated. Squeezing the clutch hand lever causes the clutch master cylinder to apply pressure via the clutch fluid in the clutch line to the secondary clutch actuator mounted to the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing which disengages the clutch.

A bleed screw at the secondary clutch actuator allows bleeding air from the clutch lines. D.O.T. 4 BRAKE FLUID is used in the clutch system.

Check the clutch fluid level in the clutch fluid reservoir on left handlebar.

- If the sight glass is dark, the fluid level in the reservoir is above the sight glass prism and the reservoir is full.
- If the sight glass appears clear, the fluid level is below the sight glass prism and the fluid level should be checked.
- Fluid level should be level with the internal shelf marked FILL LEVEL with the motorcycle upright.

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

REMOVAL

1. Remove mirror and turn signal.
2. Remove left hand control from handlebar.

NOTE

To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

3. See Figure 2-24. Loosen, but do not remove, screws (10) with flat washers (9) that detach handlebar clamp (8) from clutch master cylinder/reservoir.
4. Loosen both screws (3) on cover (1) to relieve pressure in master cylinder reservoir.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

NOTES

- *Place a large cup under the banjo fitting. Hydraulic fluid will begin draining from the reservoir as the banjo bolt is removed.*
- *Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing clutch line components.*

5. Slowly loosen banjo bolt (6) and allow clutch fluid from reservoir to drain into cup.

NOTE

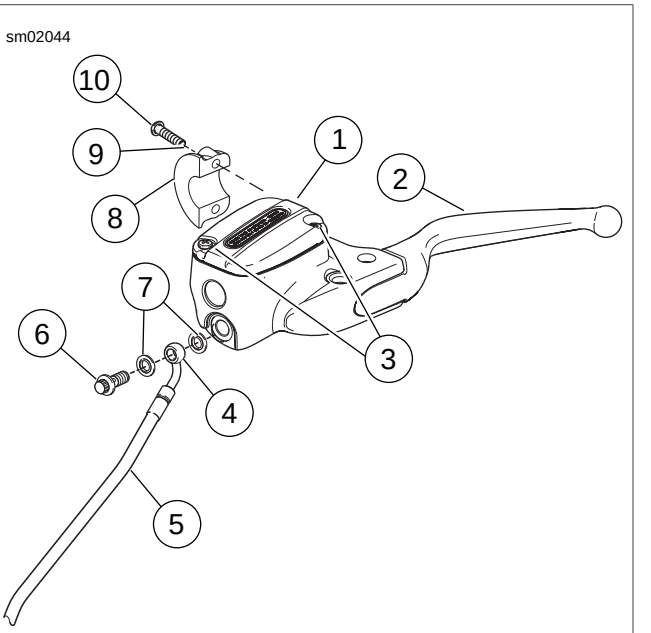
Dispose of clutch fluid in accordance with local regulations.

6. Remove banjo bolt (6) and two copper washers (7) to disconnect fitting of hydraulic clutch fluid line (5) from clutch reservoir and master cylinder. Discard copper washers.

NOTE

To prevent the rest of the clutch fluid from draining from the clutch line and secondary clutch actuator, support the banjo fitting and clutch fluid line upright. Plug the banjo bolt hole with a finger to transfer the assembly to a workbench without spilling clutch fluid.

7. Remove handlebar clamp screws and take clamp and clutch master cylinder/reservoir assembly to a workbench.



1. **Cover**
2. **Clutch hand lever**
3. **Cover hold down screws**
4. **Banjo fitting**
5. **Clutch fluid line**
6. **Banjo bolt**
7. **Copper washers**
8. **Handlebar clamp**
9. **Washer**
10. **Clamp screw**

Figure 2-24. Clutch Master Cylinder/Reservoir

DISASSEMBLY

NOTE

To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

1. Drain additional clutch fluid from master cylinder/reservoir.
2. Remove screws securing master cylinder cover. Remove cover and gasket. Turn housing upside down to remove remaining clutch fluid from reservoir.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

3. Remove retaining ring from pivot pin groove.

NOTE

To take the piston spring load off the pin and remove the pivot pin, gently force the clutch lever toward the piston (as if operating the clutch).

4. Remove pivot pin through top of housing. Remove and save pivot pin and clutch lever.
5. See Figure 2-25. Using a toothpick or small screwdriver, gently pry outer edge of piston boot (1) out of piston bore.
6. Remove piston (2) and spring (4).

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

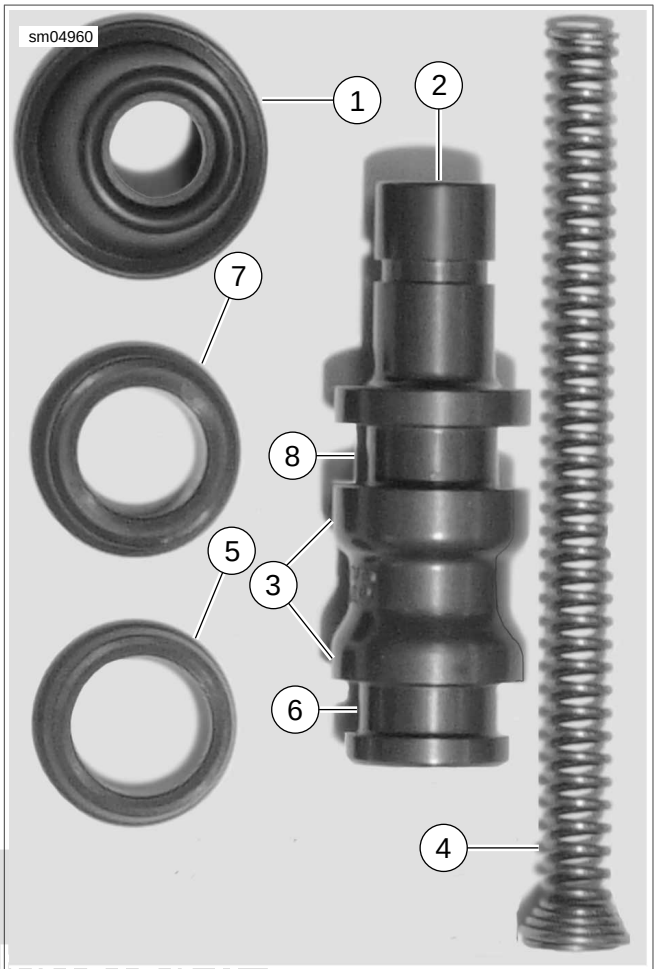
NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

Do not use a wire or sharp instrument to clean drilled oil passages.

7. Inspect cylinder housing bore for scoring, pitting or corrosion. Also check outlet port for damage. Replace housing if necessary.
8. Inspect the cover, sight glass, and gasket for cuts, tears or general deterioration.



1. **Boot**
2. **Piston**
3. **Shoulder**
4. **Spring**
5. **Primary cup**
6. **Groove - primary cup**
7. **Secondary cup**
8. **Groove - secondary cup**

Figure 2-25. Clutch Master Cylinder Components

ASSEMBLY

To rebuild clutch master cylinder, use the components found in the service parts kit.

1. See Figure 2-25. Lightly lubricate inside of primary cup (5) and fit over lip on spring end of piston (2) so the closed end (small ID) contacts evenly with the shoulder (3) in primary cup grove (6).
2. Lightly lubricate inside of secondary cup (7) (steep taper from center to outside diameter) and fit over the lip on outboard end of piston (2) so that flared end is open toward the shoulder (3) of the secondary cup groove (8).
3. Install boot (1), large sealing ID first, on piston (2) until seal on smaller ID fits snugly into thin groove in piston.

NOTE

See Figure 2-25. The flared ends of the primary cup and the secondary cup face the spring end of the piston.

4. Using lubricant in service parts kit, thoroughly coat outside diameters of primary and secondary cups. Coat master cylinder piston bore.
5. See Figure 2-25. With tapered end out, install spring (4) into opening on inboard side of piston assembly.
6. Align and install piston assembly into bore. Firmly press on flat end of piston, compressing spring, until the entire assembly slides into cylinder bore.

NOTE

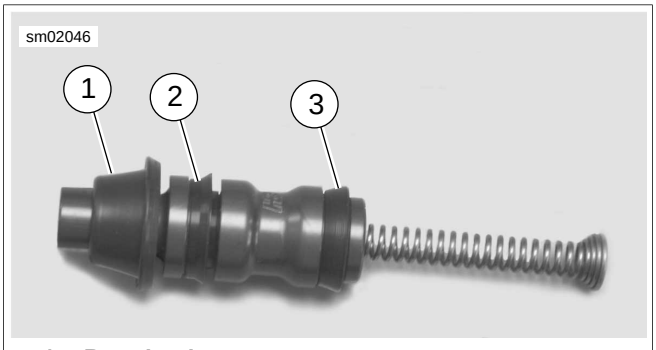
When fitting the piston sealing boot, be careful not to tear, perforate or damage the piston sealing boot.

7. Compress piston until it is even with the end of bore. Using a small dull bladed screwdriver or similar tool, gently work around sealing edges of boot until entire circumference of boot is seated in cylinder bore groove.
8. If cover gasket and/or sight glass replacement is necessary. Proceed as follows:
 a. From inboard side, push sight glass toward top of cover until free.
 b. Pull rubber gasket from cover.
 c. Fit nipple of **new** gasket into hole of cover aligning gasket and cover thru holes.
 d. From bottom of gasket, push flat end of sight glass through nipple until top of glass is flush with top of gasket. Verify that glass is square in bore. If lubrication is necessary, use clean D.O.T. 4 BRAKE FLUID.
9. Install cover with gasket on master cylinder reservoir. Install two screws to fasten the cover to reservoir, but do not tighten.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

10. To install existing clutch hand lever, install clutch hand lever, pivot pin, and a **new** retaining ring.
11. To install a replacement clutch hand lever, See 2.13 CLUTCH HAND LEVER.



1. **Boot in piston groove**
2. **Secondary cup flare**
3. **Primary cup**

Figure 2-26. Assembled Cups and Piston

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebar clamp screws	8-9 Nm	71-80 **in-lbs**
Clutch master cylinder/reservoir, banjo bolt	17-20 Nm	13-14 ft-lbs
Secondary clutch actuator, bleed screw	9-11 Nm	80-97 **in-lbs**
Clutch master cylinder/reservoir, reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**
Secondary clutch actuator cover mounting bolts	6-10 Nm	53-88 **in-lbs**

1. See Figure 2-24. Attach master cylinder/reservoir to handlebars with handlebar clamp (8). Orient lever to rider position and tighten two clamp screws (10) to 8-9 Nm (71-80 **in-lbs**).
2. Attach banjo fitting (4) of clutch fluid line to master cylinder with **new** copper washers. Install electrical controls.
3. Remove secondary clutch actuator cover and loosen bleed screw.
4. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleed screw. Finger tighten bleed screw.
5. Bleed clutch line. See 2.16 BLEEDING CLUTCH FLUID LINE.
6. Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

NOTE

Clutch fluid volume increases with clutch wear. Do not overfill clutch reservoir.

7. Verify pressure by squeezing clutch hand lever.
8. Tighten fasteners as follows:
 a. Banjo bolt (6) to 17-20 Nm (13-14 ft-lbs).
 b. Bleed screw to 9-11 Nm (80-97 **in-lbs**).
 c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
 d. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-88 **in-lbs**).

⚠WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

9. Install rear view mirror and turn signals.
10. Test ride motorcycle.

DIGITAL TECHNICIAN HARLEY-DAVIDSON®

CLUTCH HAND LEVER 2.13

REMOVAL

1. Remove retaining ring from pivot pin.
2. Remove pivot pin.
3. Slide lever free from clutch master cylinder housing.

INSTALLATION

1. See Figure 2-27. Slide bushing cups (3) onto pins of roller with cup flanges against roller.

NOTE

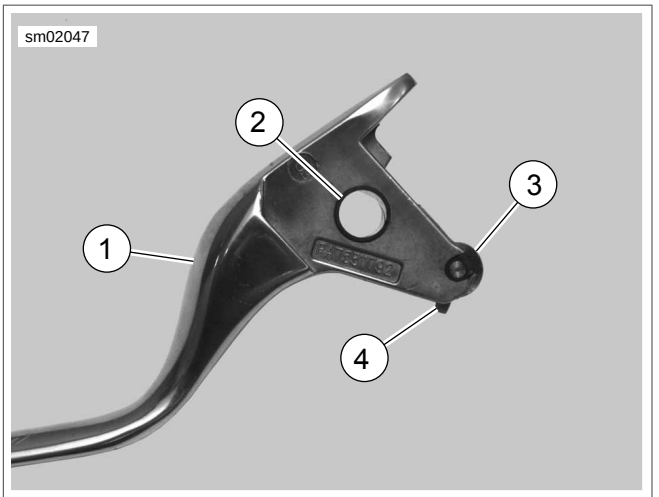
Be careful when handling the bushing cups. The hard plastic cups are easily damaged.

2. With connector bow (3) portion of the bushing cups parallel with groove in clutch handle, snap roller pin (4) with the busing cups installed into clutch lever roller groove. If bushing is positioned correctly, roller/bushing assembly will install with a snap and will be held securely.
3. Lightly grease pivot bushing (2) and install into clutch hand lever (1) pivot hole. Position bushing until it is flush with both sides of lever.

NOTE

If the clutch master cylinder/reservoir is full of clutch fluid under pressure, apply force to the hydraulic piston (in the clutch hand lever mount). This aligns the clutch hand lever for pivot pin insertion.

4. Orient clutch lever in lever mounting bracket. Insert pivot pin from top and tap into place.
5. Install retaining ring on pivot pin.



1. **Clutch hand lever**
2. **Pivot bushing installed**
3. **Bushing cups connector bow**
4. **Roller pin**

Figure 2-27. Clutch Hand Lever

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CLUTCH FLUID LINE 2.14

REMOVAL

Inspect the clutch fluid line for wear, damage, and leaks. Replace if necessary.

1. Remove secondary clutch actuator cover from left side clutch cover.

⚠ WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

2. Place a suitable container under secondary clutch actuator. Loosen flare nut and allow clutch fluid to drain from clutch line.

NOTE

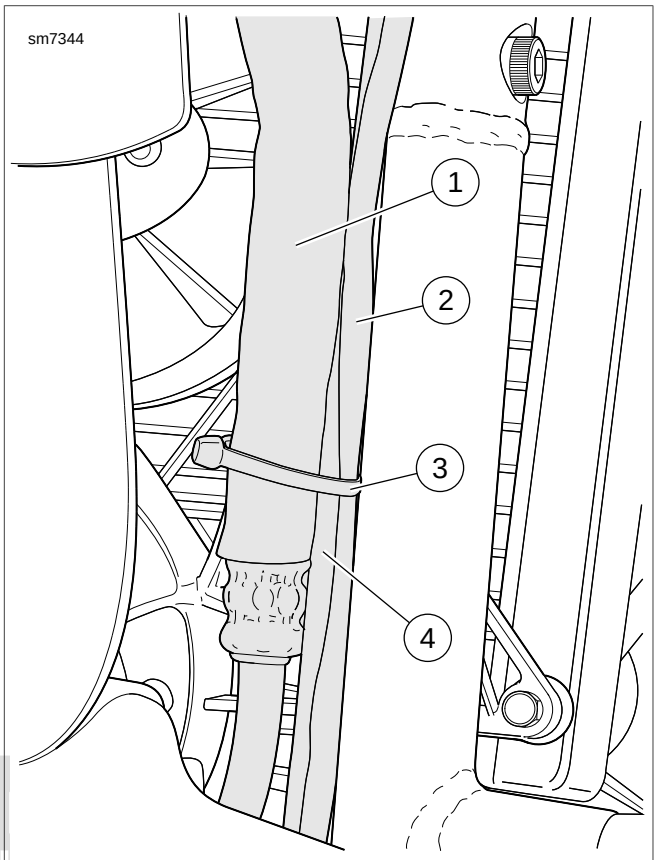
Dispose of clutch fluid in accordance with local regulations.

3. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic clutch fluid line from clutch reservoir and master cylinder. Discard washers.

NOTE

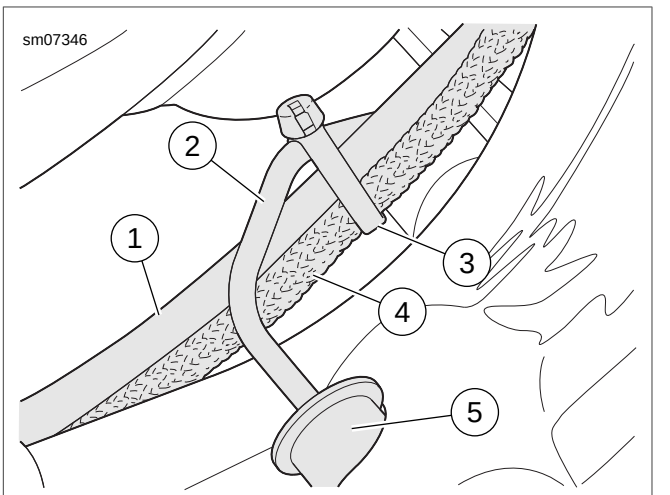
Note locations and number of clutch fluid line clips and cable straps prior to disassembly.

4. See Figure 2-28. Remove cable strap (3).
5. See Figure 2-29. Remove cable strap (3).
6. See Figure 2-30. Remove wire retainers (3, 5).
7. See Figure 2-31. Remove cable straps (1, 3).
8. Carefully thread banjo fitting end of clutch line out through upper triple clamp. Thread flare nut end of clutch line out through bottom of motorcycle and remove clutch line through front down tubes.



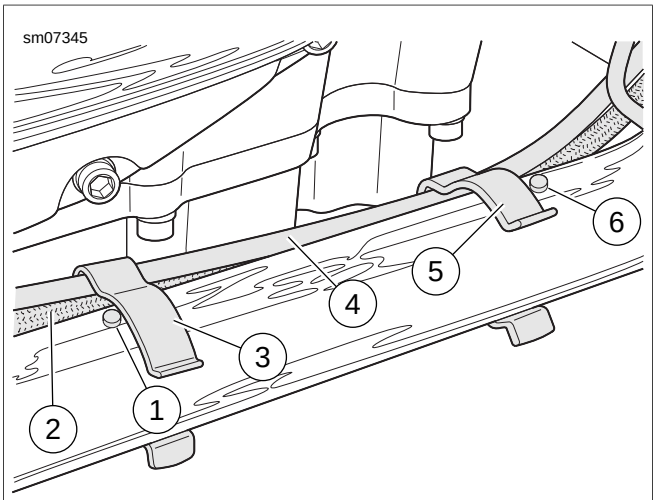
1. **Oil line**
2. **Wire harness**
3. **Cable strap**
4. **Clutch line**

Figure 2-28. Right Downtube Routing



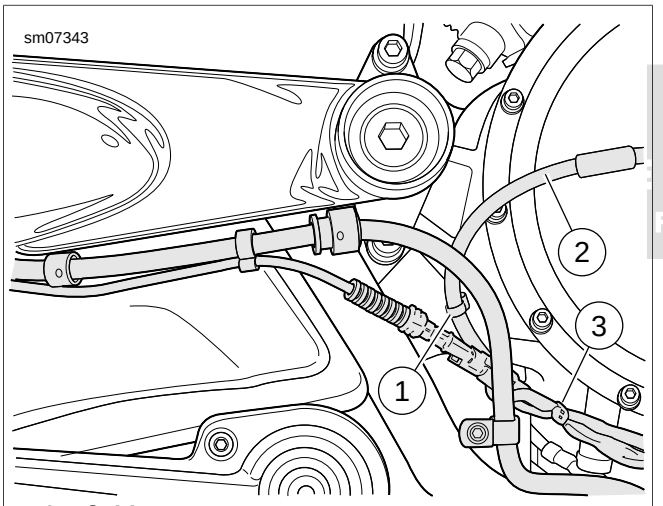
1. **Clutch line**
2. **Rear brake line to HCU**
3. **Cable strap**
4. **Wire harness**
5. **To rear brake master cylinder**

Figure 2-29. Clutch Line Routing (Right Footrest Area)



1. **T-stud**
2. **Wire harness**
3. **Wire retainer**
4. **Clutch line**
5. **Wire retainer**
6. **T-stud**

Figure 2-30. Wire Retainers



1. **Cable strap**
2. **Clutch line**
3. **Cable strap**

Figure 2-31. Clutch Line Cable Straps

INSTALLATION

FASTENER	TORQUE VALUE	
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**
Banjo bolt	23-31 Nm	17-23 ft-lbs

1. Route clutch line banjo fitting:
 a. Through upper triple clamp.
 b. Behind steering head.
 c. Over to right frame rail.
 d. Along inside of rail under engine.
 e. Back up between bottom frame rails.
 f. Loop out and forward to secondary clutch.
2. Install and finger tighten flare nut fastening clutch fluid line to secondary clutch actuator.
3. Attach banjo fitting of the clutch fluid line to master cylinder with **new** copper washers.

Tighten clutch fluid line flare nut to 9-13 Nm (80-115 **in-lbs**).

Tighten banjo bolt to 23-31 Nm (17-23 ft-lbs).

NOTE

Clutch line must be positioned between oil line and right lower frame rail to prevent possible contact with exhaust system.

4. See Figure 2-28. Install cable strap (3) to secure oil line (1), wire harness (2), clutch line (4) and rear brake line (not pictured).
5. See Figure 2-29. Install cable strap (3) to secure clutch line (1), rear brake line (2) and wire harness (4).
6. See Figure 2-30. Install wire retainers (3, 5) over clutch line and wire harness. Wire retainers should be located inside of T-studs (1, 6) and touching T-studs.
7. See Figure 2-31. Install cable straps (1, 3).
8. Bleed clutch line. See 2.16 BLEEDING CLUTCH FLUID LINE.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when adding fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00294a)

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

DIGITAL TECHNICIAN® II HARLEY-DAVIDSON®

SECONDARY CLUTCH ACTUATOR 2.15

REMOVAL

1. Remove secondary clutch actuator cover.
2. See Figure 2-32. Remove mounting bolts (2) holding secondary clutch actuator (4) to clutch cover.

NOTE

Do not operate the clutch hand lever while actuator is removed. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.

3. See Figure 2-33. Inspect O-ring (2). Replace if necessary and install actuator.

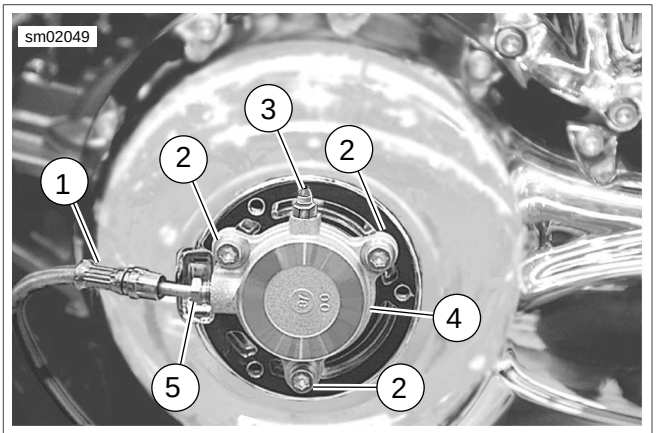
NOTE

Dispose of clutch fluid in accordance with local regulations.

4. See Figure 2-32. If condition indicates replacement of secondary actuator:
 a. Place a suitable container under secondary clutch actuator (4). Loosen flare nut (5) and allow clutch fluid to drain from clutch line (1).
 b. Remove flare nut and remove actuator.
 c. Remove bleed screw and drain remaining clutch fluid.

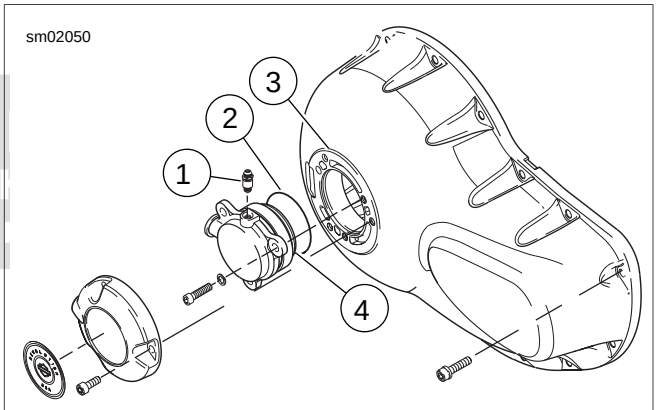
ASSEMBLY

1. See Figure 2-34. Coat cylinder bore, piston, O-ring, and bleed screw with lubricant from service kit.
2. Install a **new** seal (5) with square split lip toward rider side of actuator and fit to piston (6).
3. Insert spring into cylinder bore and insert piston into cylinder bore. Compress and guide seal lip as piston is pressed into bore.
4. Install a **new** O-ring (3) into groove at base of secondary clutch actuator housing (1).
5. Fit **new** O-ring (3) to bleed screw (2) and loosely install into housing.



1. **Clutch fluid line**
2. **Mounting bolts**
3. **Bleed screw**
4. **Secondary clutch actuator**
5. **Flare nut**

Figure 2-32. Secondary Clutch Actuator Installed



1. **Bleed screw**
2. **O-ring**
3. **Clutch release bearing**
4. **Secondary clutch actuator piston**

Figure 2-33. Secondary Clutch Actuator

INSTALLATION

PART NUMBER	TOOL NAME
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**
Banjo bolt	23-31 Nm	17-23 ft-lbs
Bleed screw	9-11 Nm	80-100 **in-lbs**
Clutch reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**
Secondary clutch actuator fasteners	10 Nm	88 **in-lbs**
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**

1. Install clutch fluid line flare nut to secondary clutch actuator. Tighten to 9-13 Nm (80-115 **in-lbs**).
2. Loosen bleed screw.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

NOTE

Do not operate the clutch hand lever while actuator is removed. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

3. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleed screw. Tighten bleed screw.

NOTE

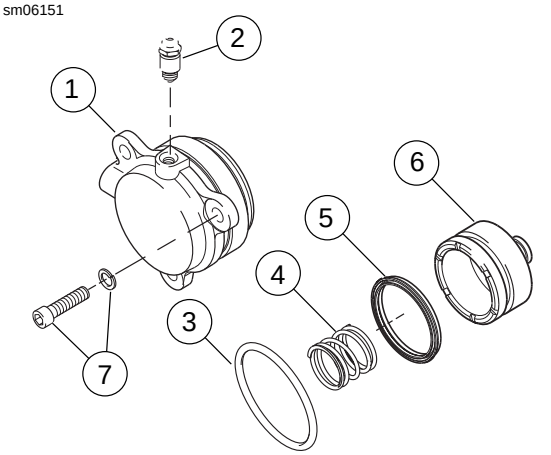
When filling an empty clutch fluid line, a BASIC VACUUM BRAKE BLEEDER (Part No. SNAP-ON BB200A) with a fitting that mates to the bleed screw threads can be used to initially draw the fluid down the clutch line with little or no air in the line.

4. Tighten fasteners as follows:
 a. Banjo bolt to 23-31 Nm (17-23 ft-lbs).
 b. Bleed screw to 9-11 Nm (80-100 **in-lbs**).
 c. Clutch reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
5. Bleed clutch fluid line. See 2.16 BLEEDING CLUTCH FLUID LINE.

NOTE

Insufficient piston travel may indicate a fluid or pressure leak somewhere in the actuator, clutch fluid line, or clutch master cylinder.

6. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).
7. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).



1. **Secondary clutch actuator housing**
2. **Bleed screw**
3. **O-ring**
4. **Spring**
5. **Seal**
6. **Piston**
7. **Mounting bolts and washers**

Figure 2-34. Secondary Clutch Actuator Components

BLEEDING CLUTCH FLUID LINE 2.16

PROCEDURE

PART NUMBER	TOOL NAME
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Reservoir banjo bolt	23-31 Nm	17-23 ft-lbs
Reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**
Bleed screw	9-11 Nm	80-100 **in-lbs**
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**

⚠WARNING

Be sure that no lubricants or fluids get on tires, wheels or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047d)

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

When filling an empty clutch fluid line, a BASIC VACUUM BRAKE BLEEDER (Part No. SNAP-ON BB200A) with a fitting that mates to the secondary clutch actuator bleed screw threads can be used to initially draw the fluid down the clutch line.

1. Stand motorcycle upright and square handlebars to level clutch reservoir. Remove reservoir cover.
2. Remove secondary clutch actuator cover.

NOTE

Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.

3. If necessary, add DOT 4 BRAKE FLUID to master cylinder reservoir. Initial fluid level should not exceed FILL LEVEL.

NOTE

Loosen banjo bolt only enough to allow air bubbles to escape.

4. While holding reservoir cover in place:
 a. Pump clutch hand lever 5 times.
 b. Hold clutch hand lever against handlebar.
 c. Hold shop towel under fitting and loosen banjo bolt.
 d. Watch banjo fitting for air bubbles.
 e. Retighten banjo fitting.
 f. Release hand lever.
5. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes banjo fitting and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.
6. Remove secondary clutch actuator cover.
7. Cover exhaust with towel and place a suitable pan under right side case to catch excess clutch fluid.
8. While holding reservoir cover in place:
 a. Pump clutch hand lever 5 times.
 b. Hold clutch hand lever against handlebar.
 c. Loosen secondary clutch actuator bleed screw.
 d. Watch bleed screw for air bubbles.
 e. Tighten bleed screw.
 f. Release hand lever.
9. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes bleed screw and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.

NOTE

Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.

10. Test pressure by squeezing clutch hand lever.

NOTE

If continued repetition of procedure does not build pressure in line and maintain FILL LEVEL, there is a leak in the clutch system. If the leak is not visible, remove and check secondary clutch actuator O-ring for leakage.

11. Tighten fasteners as follows:
 a. Reservoir banjo bolt to 23-31 Nm (17-23 ft-lbs).
 b. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
 c. Bleed screw to 9-11 Nm (80-100 **in-lbs**).
 d. Secondary clutch actuator cover fasteners to 6-10 Nm (53-88 **in-lbs**).
12. Test ride motorcycle. Incorrect pressure can cause:
 a. Dragging clutch.
 b. Hard shifting.

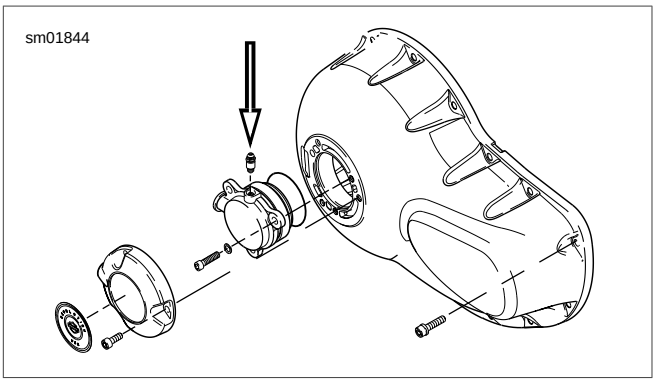


Figure 2-35. Secondary Clutch Actuator Bleed Screw

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FRONT BRAKE MASTER CYLINDER AND RESERVOIR 2.17

GENERAL

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

REMOVAL AND DISASSEMBLY

NOTE

Master cylinders designed for dual disc (two caliper) operation have an 15 mm (19/32 in.) bore.

1. Open bleed screw nipple caps on front brake calipers.
 a. Install clear plastic tubing over each caliper bleed valve, while placing free ends in a suitable container.
 b. Open bleed valves about 3/4-turn. Pump brake hand lever to drain brake fluid from reservoir.
 c. Close bleed valve. See 2.21 BLEEDING BRAKES.
2. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic brake line from front brake master cylinder. Discard washers.

NOTICE

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

3. See Figure 2-36. Install cardboard insert (2) between brake lever and reservoir housing.
4. See Figure 2-37. Remove screws (21) to detach handlebar clamp (20) from master cylinder reservoir (6).

⚠WARNING

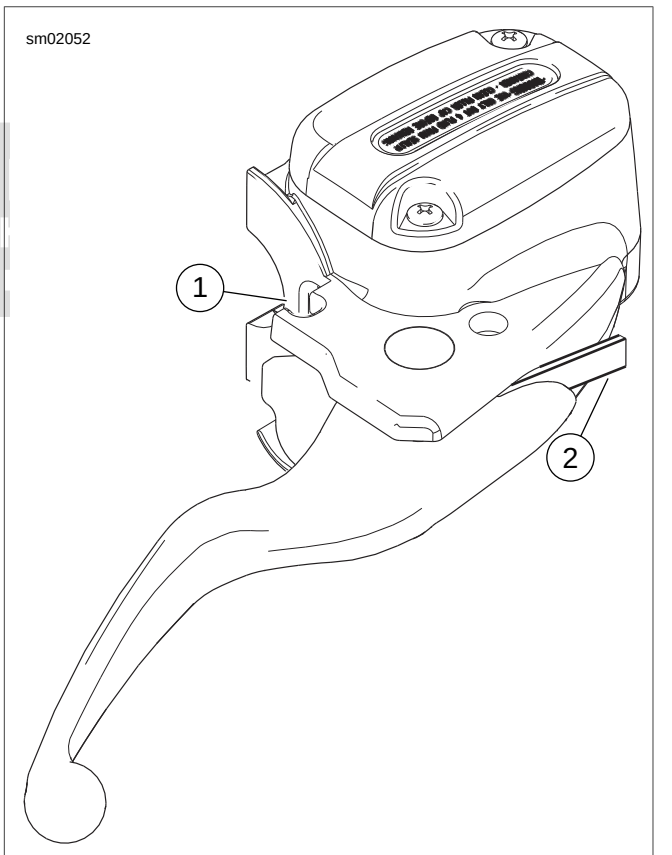
Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. Remove retaining clip (10) from pivot pin (7) and remove brake hand lever (9) from master cylinder.
6. Remove push rod (19), dust cover (18) and retainer clip (17).
7. Remove piston (15) and spring (11) from master cylinder bore.

NOTE

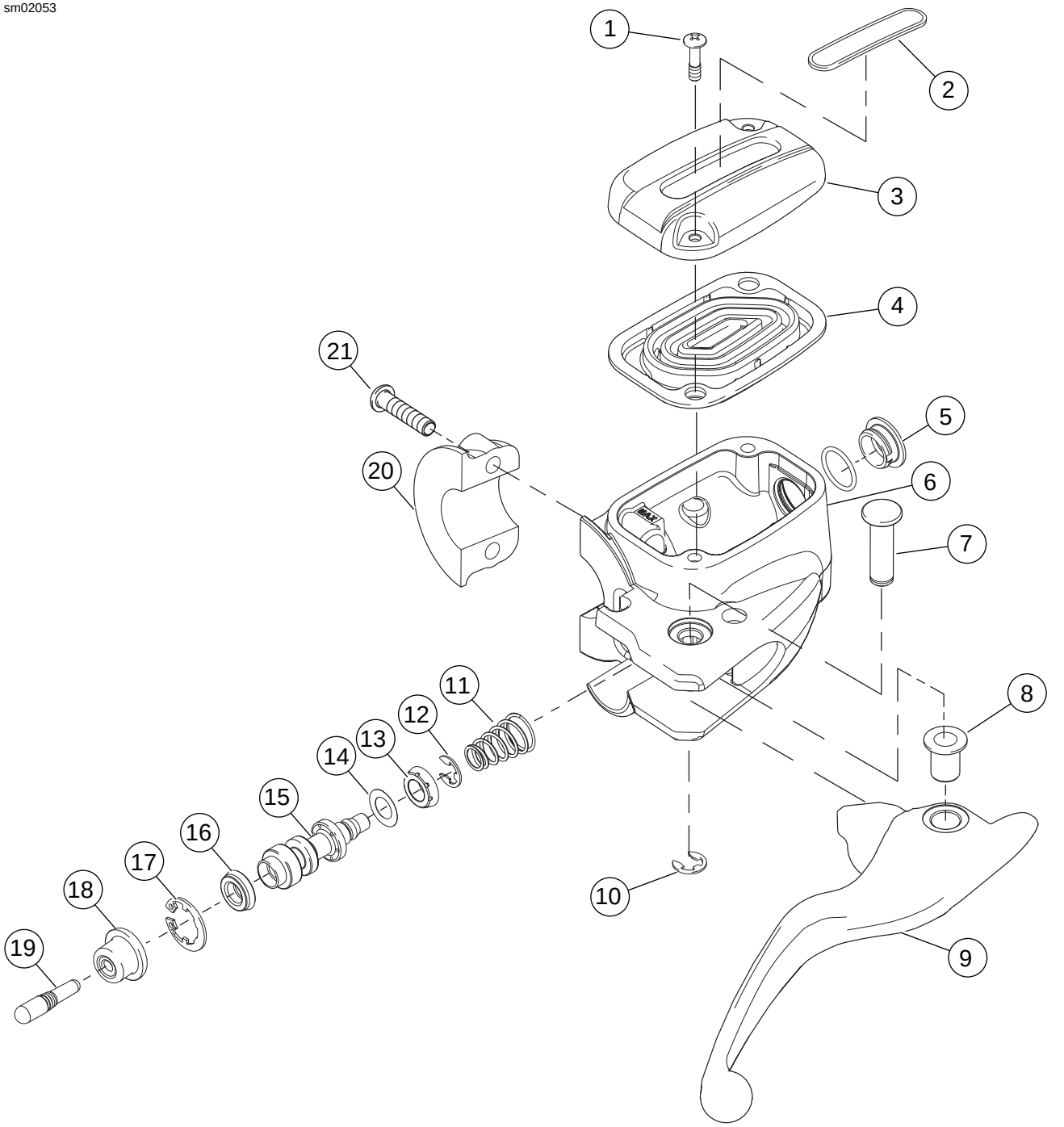
To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

8. Remove both screws (1), cover (3) and cover gasket (4).



1. Groove
2. 4 mm (5/32 in.) thick cardboard insert

Figure 2-36. Front Brake Master Cylinder and Reservoir



1. Screw (2)
2. Label (D.O.T. 4)
3. Cover
4. Gasket
5. Sight glass and retaining clip
6. Master cylinder reservoir
7. Pivot pin
8. Bushing
9. Brake hand lever
10. Retaining clip
11. Spring
12. Retaining clip
13. Primary seal
14. Washer
15. Piston
16. Secondary seal
17. Retaining clip
18. Dust cover
19. Push rod
20. Handlebar clamp
21. Screw

Figure 2-37. Front Brake Master Cylinder

CLEANING AND INSPECTION

1. Always assemble master cylinder using **new** parts from repair kit.

⚠WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

2. Clean all parts with denatured alcohol or D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth.

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

3. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.
4. Carefully inspect all parts for wear or damage and replace as necessary.
5. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace master cylinder if any of these conditions are found.
6. Inspect outlet port that mates with brake line fitting. If any scratches, dents or other damage is found on this critical sealing surface, replace housing.
7. Inspect cover, sight glass and gasket for cuts, tears or general deterioration. If gasket and/or sight glass replacement is necessary, proceed as follows:
 a. See Figure 2-37. From inboard side, push sight glass (5) out of casting.
 b. Pull rubber gasket (4) from cover (3).

NOTE

Cover gasket is unidirectional and will only fit properly one way. Verify correct installation before completing assembly.

 c. Fit **new** gasket into cover, aligning gasket and cover thru holes.

ASSEMBLY

To rebuild front brake master cylinder, use the components found in the Service Parts Kit.

1. Install **new** front master cylinder kit. Kit includes: primary seal, secondary seal, piston valve, and spring as an assembly.

NOTE

Apply a drop of grease (supplied with brake kit) to each end of push rod before installation. DO NOT use this grease on master cylinder internal parts.

2. See Figure 2-37. Press down on piston and spring assembly into the cylinder bore and install retaining clip (17). Retaining clip must be completely seated in groove on outlet side of piston bore. Install dust cover (18) and push rod (19).
3. Install cover (3) with gasket (4) on master cylinder reservoir. Snug screws (1) to fasten the cover to reservoir. Do not tighten screws at this time.
4. Align hole in brake hand lever with hole in master cylinder reservoir (6). From top of assembly, slide pivot pin (7) through reservoir and hand lever.
5. Install retaining clip (10) in pivot pin groove. Verify that retaining clip is completely seated in groove and verify proper function of master cylinder assembly.

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebar clamp and master cylinder housing screws	8-9 Nm	71-80 **in-lbs**
Front brake master cylinder banjo bolt	17-20 Nm	13-15 ft-lbs
Front brake master cylinder cover screws	1.1-1.4 Nm	10-12 **in-lbs**

NOTICE

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

1. See Figure 2-38. Position brake lever/master cylinder assembly inboard of switch housing assembly engaging tab (2) on lower switch housing (1) in groove (3) at top of brake lever bracket (4).
2. Install cardboard insert (2) between brake lever and reservoir housing.
3. Align holes in handlebar clamp with those in master cylinder housing and start both screws with flat washers. Position for rider posture. Beginning with top screw, tighten to 8-9 Nm (71-80 **in-lbs**).

NOTICE

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

4. Position **new** copper washers on each side of hydraulic brake line fitting. Insert banjo bolt through washers and fitting. Thread banjo bolt into master cylinder housing and tighten to 17-20 Nm (13-15 ft-lbs).
5. Install length of clear plastic tubing over caliper bleed valve, if removed. Place free end of tube in a clean container.

6. Stand the motorcycle upright so that master cylinder is level. Remove master cylinder cover.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

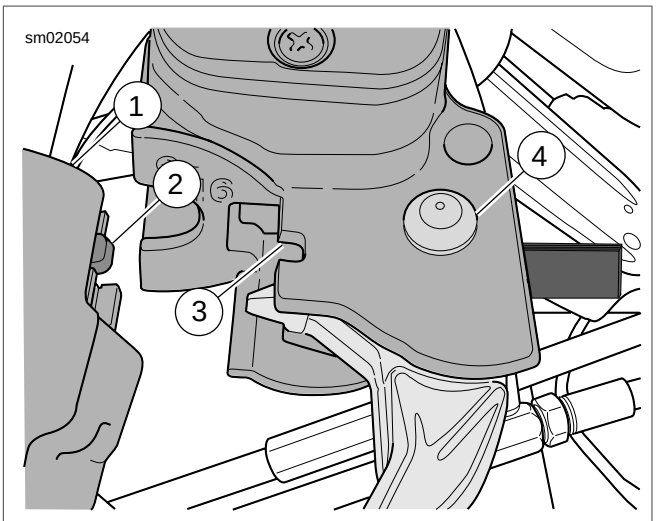
D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

7. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir until fluid level is 5.0 mm (13/64 in.) from top. Do not reuse old brake fluid. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

8. Bleed brake system. See 2.21 BLEEDING BRAKES.



1. Lower switch housing assembly
2. Tab
3. Groove
4. Brake lever bracket

Figure 2-38. Master Cylinder and Brake Lever To Handlebar Switch Housing (typical)

⚠WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

9. Verify operation of master cylinder relief port. Actuate brake hand lever with cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.

10. Install gasket and cover on master cylinder. Tighten cover screws to 1.1-1.4 Nm (10-12 **in-lbs**).

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

11. Test brake system.
 a. Turn ignition switch ON. Pump brake hand lever to verify operation of brake lamp.
 b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 2.21 BLEEDING BRAKES.

NOTE

A sight glass enables the rider to visually check the brake fluid level without removing the master cylinder cover. When the reservoir is full, the sight glass is dark. As the fluid level drops, the glass lightens up to indicate this condition to the rider.

FRONT BRAKE CALIPER 2.18

REMOVAL

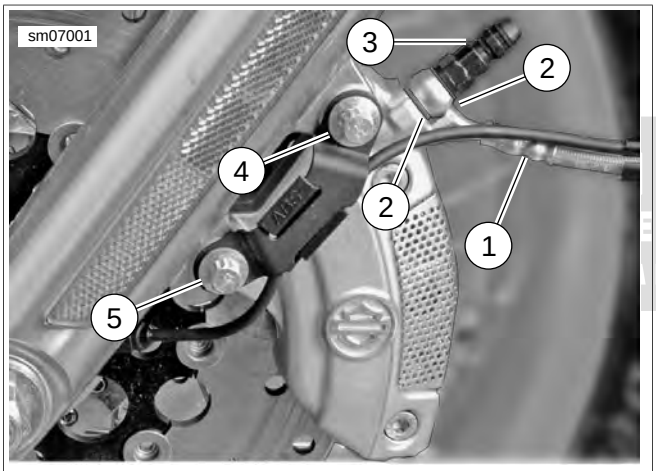
NOTE

If only replacing brake pads, see 1.14 BRAKE PADS AND DISCS.

NOTICE

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

1. Drain master cylinder reservoir using a suction device.
2. See Figure 2-39. Remove banjo bolt (3) and both copper washers (2) to detach front brake line (1) from caliper. Discard washers.
3. Remove both upper (4) and lower (5) mounting bolts (if ABS equipped, move ABS bracket out of the way). Lift caliper upward to remove from brake disc.
4. Repeat for opposite side caliper.



1. **Front brake line**
2. **Copper washer**
3. **Banjo bolt**
4. **Upper mounting bolt**
5. **Lower mounting bolt**

Figure 2-39. Front Brake Caliper Mounting (ABS model shown)

INSTALLATION

FASTENER	TORQUE VALUE	
Front brake caliper bottom mounting bolt	43-52 Nm	32-38 ft-lbs
Front brake caliper top mounting bolt	43-52 Nm	32-38 ft-lbs
Brake line banjo bolt, front caliper	23-26 Nm	17-19 ft-lbs
Resevoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**

1. Figure 2-39. Attach calipers to fork legs.
 a. Place caliper over brake disc with bleed screw facing upwards.
 b. Place ABS bracket on caliper (if ABS equipped and left side only).
 c. Loosely install upper mounting bolt (4) into top hole on fork leg.
 d. Install lower mounting bolt (5) into bottom hole on fork leg. Tighten bottom mounting bolt to 43-52 Nm (32-38 ft-lbs).
 e. Final tighten the top mounting bolt to 43-52 Nm (32-38 ft-lbs).

NOTICE

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

2. Connect the brake line (1) to caliper using two **new** copper washers (2) and banjo bolt (3). Tighten to 23-26 Nm (17-19 ft-lbs).
3. Repeat for opposite side caliper.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

4. Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at FILL LEVEL when the motorcycle is level.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

5. Bleed brake system and tighten bleed screw. See 2.21 BLEEDING BRAKES.

⚠WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

6. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
7. Push diaphragm back in if extended and install gasket and cover on reservoir.
8. Tighten reservoir cover screws to 1.1-1.4 Nm (10-12 **in-lbs**).

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

9. Test brake system.
 a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 2.21 BLEEDING BRAKES.

NOTE

Avoid making hard stops for the first 160 km (100 miles). This allows the new pads to become conditioned to the brake discs.

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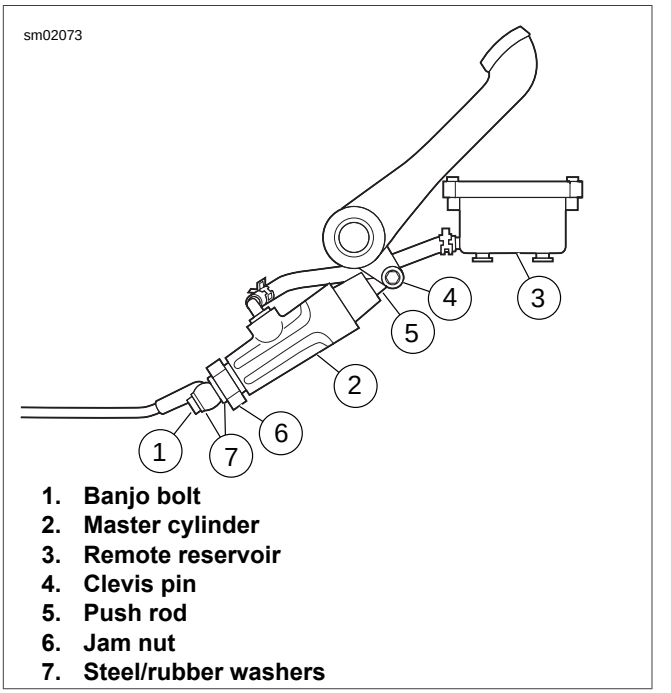
REAR BRAKE MASTER CYLINDER AND RESERVOIR 2.19

REMOVAL

NOTE

Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

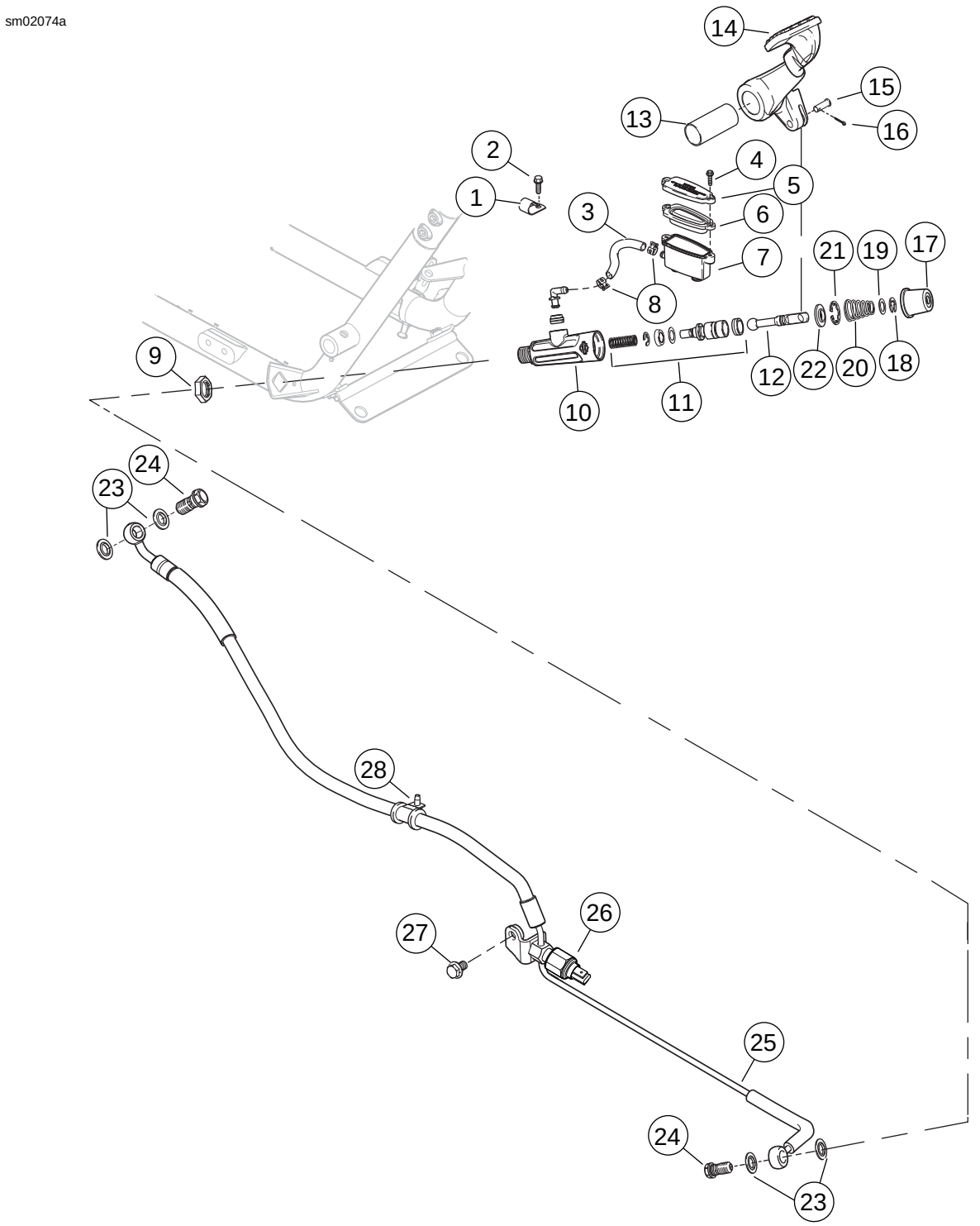
1. Remove radiator right side cover.
2. See Figure 2-40. With a suitable container under the master cylinder, remove the banjo bolt (1). Discard the two steel/rubber washers (7).
3. Remove the clip from the clevis pin (4).
4. Cover the outside face of clevis pin (4) with cardboard and using a large pliers, squeeze the pin until the pin shoulder pops out of its interference fit with the clevis. Remove the clevis pin.
5. Remove the push rod (5) from the clevis.
6. Pull remote reservoir from slot on radiator cover.
7. Remove jam nut (6) to free master cylinder from mounting bracket.
8. Remove master cylinder with the remote reservoir.



1. **Banjo bolt**
2. **Master cylinder**
3. **Remote reservoir**
4. **Clevis pin**
5. **Push rod**
6. **Jam nut**
7. **Steel/rubber washers**

Figure 2-40. Rear Brake Master Cylinder & Reservoir

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Clip
2. Screw
3. Hose
4. Screw
5. Reservoir cover
6. Gasket
7. Reservoir
8. Clamps
9. Jam nut
10. Cartridge housing
11. Piston valve assembly
12. Push rod
13. Brake pedal bushing
14. Brake pedal
15. Clevis pin
16. Cotter pin
17. Dust seal
18. Retainer clip (small)
19. Washer
20. Spring
21. Retainer clip (large)
22. Retainer washer
23. Steel/rubber washers
24. Banjo bolts
25. Brake line
26. Stoplamp switch
27. Bolt
28. Frame clip

Figure 2-41. Rear Brake Master Cylinder/Reservoir (Non-ABS Shown)

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-41137	HOSE CLAMP PLIERS

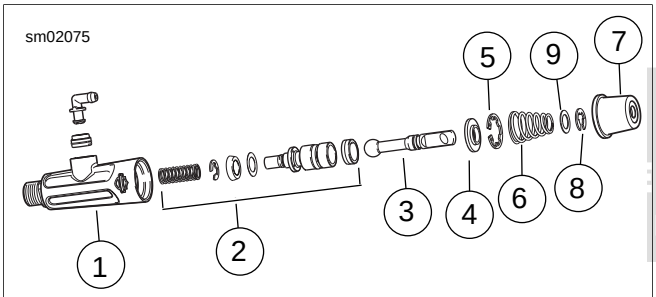
⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

1. See Figure 2-41. Remove reservoir cover (5) and gasket (6).



1. **Cartridge housing (shown w/elbow and O-ring)**
2. **Piston valve assembly (see VRSC parts manual)**
3. **Push rod**
4. **Retainer washer**
5. **Retainer clip (large)**
6. **Spring**
7. **Dust seal**
8. **Retainer clip (small)**
9. **Washer**

Figure 2-42. Master Cylinder Components

2. Over suitable container, use HOSE CLAMP PLIERS (Part No. HD-41137) to remove hose clamps (8) from reservoir hose (3). Drain reservoir (7) and hose.
3. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
4. Gently pull dust seal (17) from cartridge housing (10).

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. See Figure 2-42. Using hand pressure, push down on spring (6) and remove small retainer clip (8), washer (9) and remove spring.
6. Using hand pressure, push in push rod (3). Using a snap ring pliers, remove large retainer clip (5) and retainer washer (4).
7. Remove push rod (3).
8. Remove piston valve assembly (2) from cartridge housing (1).

CLEANING AND INSPECTION

⚠WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

1. Clean all rubber parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
2. Inspect threads on the cartridge body. Replace if threads are damaged.
3. Inspect spring for cracks or broken coils. Replace as necessary.
4. Wipe bore of cartridge housing with D.O.T. 4 BRAKE FLUID.
5. Inspect reservoir cover gasket for cuts, tears or general deterioration. Replace as necessary.

ASSEMBLY

1. See Figure 2-42. Lubricate inner bore of cartridge housing (1) with D.O.T.4 brake fluid.
2. Install **new** piston valve assembly (2) from service parts kit.
3. Lay down a clean shop cloth and stand cartridge housing upright.

NOTE

Apply a small drop of grease to each end of push rod before assembly. DO NOT use this grease on internal master cylinder parts.

4. Insert ball end of push rod (3) into piston valve assembly (2). Using hand pressure, push down to compress spring. Install retainer washer (4), and larger retainer clip (5) using snap ring pliers into groove of cartridge housing.
5. Verify larger retainer clip has seated in groove of cartridge housing body.
6. Using hand pressure, push down on spring (6) and install small washer (9) and small retainer clip (8), locking small retainer clip into groove on push rod.
7. Verify small retainer clip has seated properly into groove on push rod.

8. Install dust seal (7) over push rod and seat base of dust seal into bore of cartridge housing until base of seal is below bore opening.
9. Test function of master cylinder assembly. Check for binding or excessive drag when pushing down on push rod.

INSTALLATION

FASTENER	TORQUE VALUE	
Rear brake master cylinder jam nut	41-54 Nm	30-40 ft-lbs
Rear brake master cylinder banjo bolt	23-26 Nm	17-19 ft-lbs
Rear brake reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**

1. See Figure 2-41. Route remote reservoir (7) and hose (3) behind rear brake pedal (14). Press reservoir mounting studs into slots on radiator cover.
2. Fit square on bottom of master cylinder cartridge housing (10) into square hole of mounting bracket.
3. Install clevis pin (15) through the brake pedal clevis and master cylinder push rod (12).
4. Cover the face of clevis pin and clevis with cardboard. Holding the brake pedal firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install new clip.
5. Apply LOCTITE 243 (blue) to threads of jam nut (9). Thread jam nut on cartridge housing and tighten to 41-54 Nm (30-40 ft-lbs).

NOTE

To avoid leakage, verify that the banjo bolt, brake line fitting and master cylinder bore are completely clean.

6. Lubricate **new** copper washers (7) with D.O.T. 4 BRAKE FLUID. Position washers on each side of brake line. Insert the banjo bolt through washers and fitting. Tighten to 23-26 Nm (17-19 ft-lbs).
7. Stand the motorcycle upright so that the reservoir is in a level position. Clean and remove reservoir cover.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

8. See Figure 2-43. Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 12.7 mm (1/2 in.) below top of reservoir and is visible in sight glass at rear of reservoir. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

9. Bleed brake system. See 2.21 BLEEDING BRAKES.
10. Install gasket and cover on master cylinder. Tighten cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
11. Install radiator side cover.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

12. Test brake system.
 a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
 b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 2.21 BLEEDING BRAKES.



Figure 2-43. Rear Brake Reservoir Sight Glass (removed from motorcycle)

REAR BRAKE CALIPER 2.20

REMOVAL

FASTENER	TORQUE VALUE	
Rear brake caliper fastener	58-66 Nm	43-48 ft-lbs

NOTES

- *If removing caliper, remove brake pads first. If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.14 BRAKE PADS AND DISCS.*
- *Protect wheel from scratches during caliper removal and installation.*

1. Drain master cylinder brake reservoir using a suction device.

NOTICE

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

2. Remove banjo bolt and both copper washers to detach rear brake line from caliper. Discard washers.
3. With motorcycle supported from underneath, remove fastener from caliper.

NOTE

Caliper can be removed without rear wheel removal. Follow steps above and remove fastener shown and remove caliper. Fastener torque is 58-66 Nm (43-48 ft-lbs).

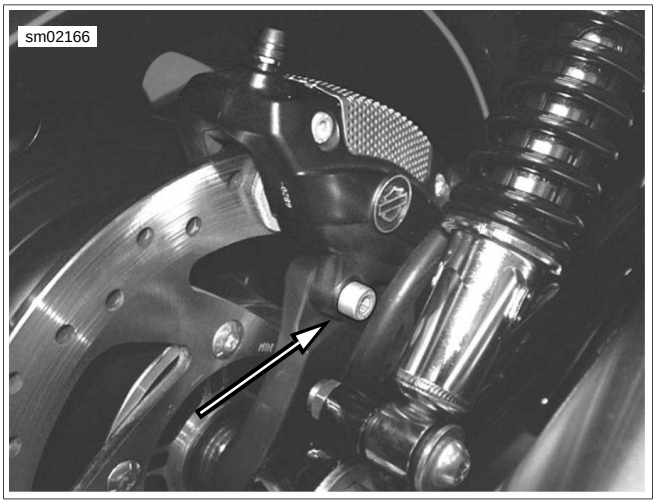


Figure 2-44. Two-Piece Caliper Fastener Location

4. Lift rear caliper away from axle and rear fork.

INSTALLATION

FASTENER	TORQUE VALUE	
Rear brake caliper banjo bolt	23-26 Nm	17-19 ft-lbs

1. Place caliper on caliper bracket with notch inside rear fork weldment. Verify that rubber bumper is contacting underside of the caliper weldment for the full length of bumper.
2. Install caliper to caliper bracket fastener and tighten to 58-66 Nm (43-48 ft-lbs).

NOTICE

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

3. Connect brake line to caliper using two **new** copper washers and banjo bolt. Tighten to 23-26 Nm (17-19 ft-lbs).

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

4. Remove radiator side cover to access master cylinder. See 2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR. Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at the FILL LEVEL boss when the motorcycle is level.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

5. Bleed brake system. See 2.21 BLEEDING BRAKES.
6. Install radiator side cover.

7. Test brake system.
 a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
 b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 2.21 BLEEDING BRAKES.

NOTE

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake discs.*

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

BLEEDING BRAKES 2.21

GENERAL

⚠WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

⚠WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

NOTICE

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

Front brake hand lever and rear brake foot pedal must have a firm feel when brakes are applied. If not, bleed system as described.

PROCEDURE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Brake caliper bleeder valve	9.0-11.3 Nm	80-100 **in-lbs**
Front master cylinder reservoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**
Rear master cylinder reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**

NOTES

- *For best results, use the BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool, particularly if the brake system was completely drained. Refer to the instructions provided with the tool. If a vacuum brake bleeder is not available, use the procedure which follows.*
- *ABS equipped models require the use of DIGITAL TECHNICIAN II (Part No. HD-48650) to confirm that lines are properly connected and that air is adequately bled from ABS system.*

1. Remove bleeder valve cap. Install end of clear plastic tubing over bleeder valve and place free end in a clean container.
2. Position vehicle or handlebar so master cylinder reservoir is level.

NOTE

Wrap a clean shop cloth around the outside of the master cylinder reservoir to protect paint from brake fluid spills.

NOTICE

Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)

3. Remove cover from master cylinder reservoir.

⚠WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

4. Add brake fluid as necessary and verify proper operation of the master cylinder relief port by actuating the brake pedal or lever. A slight spurt of fluid will break the fluid surface in the reservoir if all internal components are working properly. Refer to Table 2-8.
5. Operate the brake lever or pedal to build hydraulic pressure.

NOTE

Pay careful attention to fluid level in the master cylinder reservoir. Add fluid before it empties to avoid drawing air into the brake lines.

6. While holding pressure with the brake lever or pedal:
 a. Open bleeder valve about 3/4 turn.
 b. Close bleeder valve as soon as the lever or pedal has moved full range of travel.
 c. Allow brake lever or pedal to return slowly to its released position.
7. Repeat steps until all air bubbles are purged and a solid column of fluid is observed in the bleeder tube.
8. Tighten bleeder valve to specification. Refer to Table 2-9. Install bleeder valve cap.

NOTE

If bleeding a dual caliper brake system, repeat steps to bleed the second brake line and caliper.

9. Check and fill reservoir to specified level.
10. Refer to Table 2-9. Verify gasket and sealing surfaces are free of debris. Install master cylinder reservoir cover as follows:
 a. Front master cylinder reservoir: Orient the cover with the vent holes facing the rear. Install cover screws and tighten to specification.
 b. Rear master cylinder reservoir: Install cover screws and tighten to specification.
11. If vehicle is ABS equipped, connect DIGITAL TECHNICIAN II (Part No. HD-48650) and follow the brake bleeding procedure.

NOTE

Dispose of used brake fluid in accordance with local regulations.

12. Verify brake lamp operation.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

13. Test ride motorcycle. Repeat the bleeding procedure if brakes feel spongy.

Table 2-8. Fluid Level

ITEM	SPECIFICATION
Front reservoir	Boss or ridge
Rear reservoir	Ledge or range window

Table 2-9. Torque Specifications

COMPONENT	TORQUE
Bleeder	9.0-11.3 Nm (80-100 **in-lbs**)
Front Cover	1.1-1.4 Nm (10-12 **in-lbs**)
Rear Cover	0.7-0.9 Nm (6-8 **in-lbs**)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

HANDLEBARS: VRSCDX 2.22

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove throttle cables from throttle control. See 2.11 THROTTLE CABLES.
3. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR.
4. Remove switch housing from right handlebar. See 7.29 RIGHT HANDLEBAR SWITCH.
5. Cut clip holding wiring harness to right handlebar.
6. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
7. Remove switch housing from left handlebar. See 7.30 LEFT HANDLEBAR SWITCH.
8. Cut clip holding wiring harness to left handlebar.
9. Remove the instrument cluster from the handlebar top clamp. See 7.20 INSTRUMENT CLUSTER: VRSCDX.
10. See Figure 2-46. Supporting the handlebars (3), loosen and remove the 4 fasteners (1) holding the top clamp (2).
11. Remove the handlebars (3).
12. If necessary, remove the handgrip.
13. If necessary, loosen and remove the two fasteners (5) securing riser (4) to upper fork clamp and remove the riser (4).

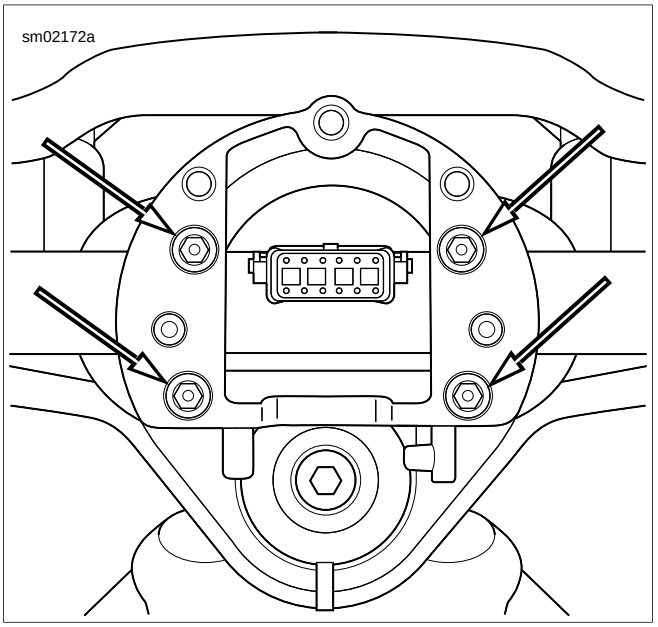
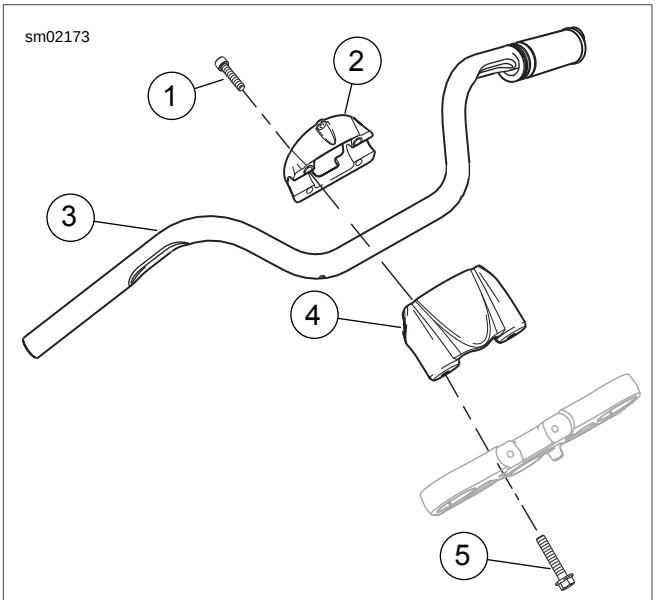


Figure 2-45. Handlebar Top Clamp Fasteners



1. **Top clamp fastener**
2. **Top clamp**
3. **Handlebar**
4. **Riser**
5. **Fastener**

Figure 2-46. Top Clamp, Handlebar, and Riser (typical)

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebar (VRSCDX), cast riser fasteners	41-47 Nm	31-35 ft-lbs
Handlebar (VRSCDX) clamp, rear fasteners	16-20 Nm	12-15 ft-lbs
Handlebar (VRSCDX) clamp, front fasteners	16-20 Nm	12-15 ft-lbs

1. Install cast riser on upper triple clamp. Tighten fasteners to 41-47 Nm (31-35 ft-lbs).
2. Mount handlebar on riser with top clamp. Thread in and tighten fasteners to hold handlebar.
3. Center handlebars. Verify that equal amounts of knurled areas on handlebar protrude from sides of upper handlebar clamp.
4. See Figure 2-47. Position handlebars so they are 15 to 17 degrees from fork angle (towards rider).
5. See Figure 2-46. Hold handlebars in position.
6. Tighten two front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp.
7. Tighten rear fasteners to 16-20 Nm (12-15 ft-lbs).
8. Final tighten front fasteners to 16-20 Nm (12-15 ft-lbs). Slight gap between upper and lower clamps should exist at rear.

9. Install instrument cluster. See 7.20 INSTRUMENT CLUSTER: VRSCDX.

NOTE

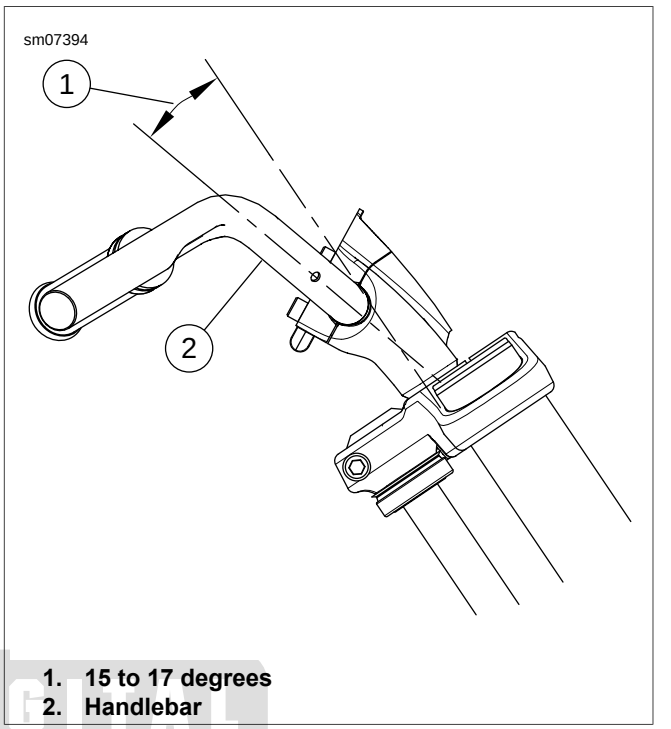
Before applying adhesive, clean the left handlebar with acetone.

10. If removed, install left handgrip:
 a. Using emery cloth, rough grip end of left handlebar.
 b. Apply LOCTITE 770 PRISM PRIMER to inside of **new** handgrip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
 c. Apply LOCTITE 411 PRISM INSTANT ADHESIVE to inside of handgrip. Install handgrip on left handlebar.

NOTE

LOCTITE 411 PRISM INSTANT ADHESIVE will set in four minutes and be fully cured in 24 hours.

11. Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR.
12. Install a **new** clip to hold the wiring harness to the left handlebar.
13. Install left handlebar switch housing. See 7.30 LEFT HANDLEBAR SWITCH.
14. Install throttle cable to throttle control handgrip. See 2.11 THROTTLE CABLES.
15. Install right turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
16. Install a **new** clip to hold wiring harness to the right handlebar.
17. Install right handlebar switch housing. See 7.29 RIGHT HANDLEBAR SWITCH.
18. Install main fuse.



1. 15 to 17 degrees
2. Handlebar

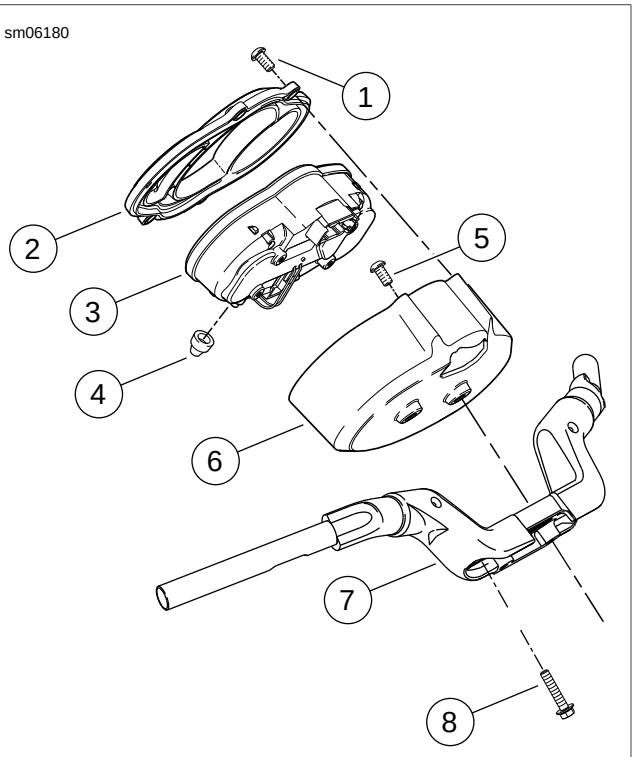
Figure 2-47. Handlebar Position

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

HANDLEBARS: VRSCF 2.23

REMOVAL

1. Remove right side cover, left side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove headlight. See 7.13 HEADLAMP.
3. Remove throttle cables from throttle control. See 2.11 THROTTLE CABLES.
4. Disconnect left hand control connector [24], right hand control connector [22] and front turn signal connector [31].
5. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR.
6. Remove switch housing from right handlebar. See 7.29 RIGHT HANDLEBAR SWITCH.
7. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
8. Remove switch housing from left handlebar. See 7.30 LEFT HANDLEBAR SWITCH.
9. See Figure 2-48. Remove wiring harness connector to instrument cluster and remove instrument cluster (3). See 7.21 INSTRUMENT CLUSTER: VRSCF.
10. Remove the two screws (5) securing the instrument cluster housing (6) to the handlebars (7) and remove housing.
11. Remove fasteners (8) holding handlebars (7) to upper triple clamp. Remove handlebars.
12. If necessary, remove the handgrip.



1. **Screw, instrument cluster bezel (4)**
2. **Bezel, instrument cluster**
3. **Instrument cluster**
4. **Boot, reset switch**
5. **Screw, instrument cluster housing to handlebars (2)**
6. **Instrument cluster housing**
7. **Handlebars**
8. **Fasteners, handlebar mount (2)**

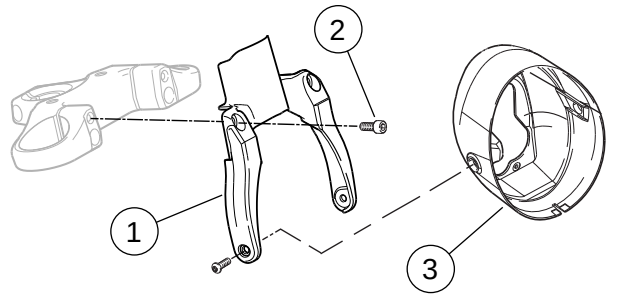
Figure 2-48. Handlebar Assembly (VRSCF)

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebars (VRSCF) bolts	41-47 Nm	31-35 ft-lbs
Instrument cluster housing fasteners	4-7 Nm	35.4-62.0 **in-lbs**
Headlamp bracket fasteners, VRSCF	11-18 Nm	108-156 **in-lbs**

1. See Figure 2-48. Mount handlebars (7) on upper triple clamp. Tighten handlebar fasteners (8) to 41-47 Nm (31-35 ft-lbs).
2. Mount the instrument cluster housing (6) by installing the two screws (5) that secure the housing to the handlebars (7), tighten screws to 4-7 Nm (35.4-62.0 **in-lbs**).
3. Install instrument cluster (3) and connect wiring harness to instrument cluster. See 7.21 INSTRUMENT CLUSTER: VRSCF.

4. See Figure 2-49. Install headlamp and tighten headlamp bracket fasteners (2) to 11-18 Nm (108-156 **in-lbs**).



1. **Headlamp bracket**
2. **Socket head screw**
3. **Headlamp assembly**

Figure 2-49. Headlamp: VRSCF

5. Install left handgrip. See 2.24 HAND GRIPS, Left Hand Grip.
6. Install left turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
7. Install left handlebar switch housing. See 7.30 LEFT HANDLEBAR SWITCH.
8. Install a **new** clip to hold the wiring harness to the left handlebar.
9. Install right turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR.
10. Install right handlebar switch housing. See 7.29 RIGHT HANDLEBAR SWITCH.
11. Install a **new** clip to hold wiring harness to the right handlebar.
12. Install throttle cable to throttle control handgrip. See 2.11 THROTTLE CABLES.
13. Connect left hand control connector [24], right hand control connector [22] and front turn signal connector [31].
14. Install main fuse, left side cover and right side cover.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

HAND GRIPS 2.24

RIGHT HAND GRIP

To replace right hand grip, see 7.29 RIGHT HANDLEBAR SWITCH and 2.11 THROTTLE CABLES.

LEFT HAND GRIP

Removal

1. Remove left handlebar switch controls. See 7.30 LEFT HANDLEBAR SWITCH.
2. Use a sharp blade to carefully cut rubber and then peel off handlebar.
3. Thoroughly clean handlebar to remove all residual adhesive.

Installation

1. Obtain a **new** left hand grip and LOCTITE 411 PRISM INSTANT ADHESIVE. Apply a coat of the adhesive to the inside surface of the grip 25.4 mm (1.0 in) from the open end. Apply a coat to the end of the handlebar.

NOTE

If the left hand grip is patterned, align it with the pattern on the right grip with the throttle in the fully closed position.

2. Immediately push grip completely onto end of handlebar using a twisting motion. Do not hesitate when installing grip or adhesive may dry before installation is complete.
3. Let 6-8 hours elapse at 21 °C (70 °F) to allow adhesive to fully cure.
4. Install left handlebar switch controls. See 7.30 LEFT HANDLEBAR SWITCH.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FRONT WHEEL 2.25

GENERAL

Maximum tire mileage and good handling qualities are directly related to wheel and tire care. Wheels and tires should be inspected regularly for wear. If handling problems occur, see 2.27 SEALED WHEEL BEARINGS for possible causes.

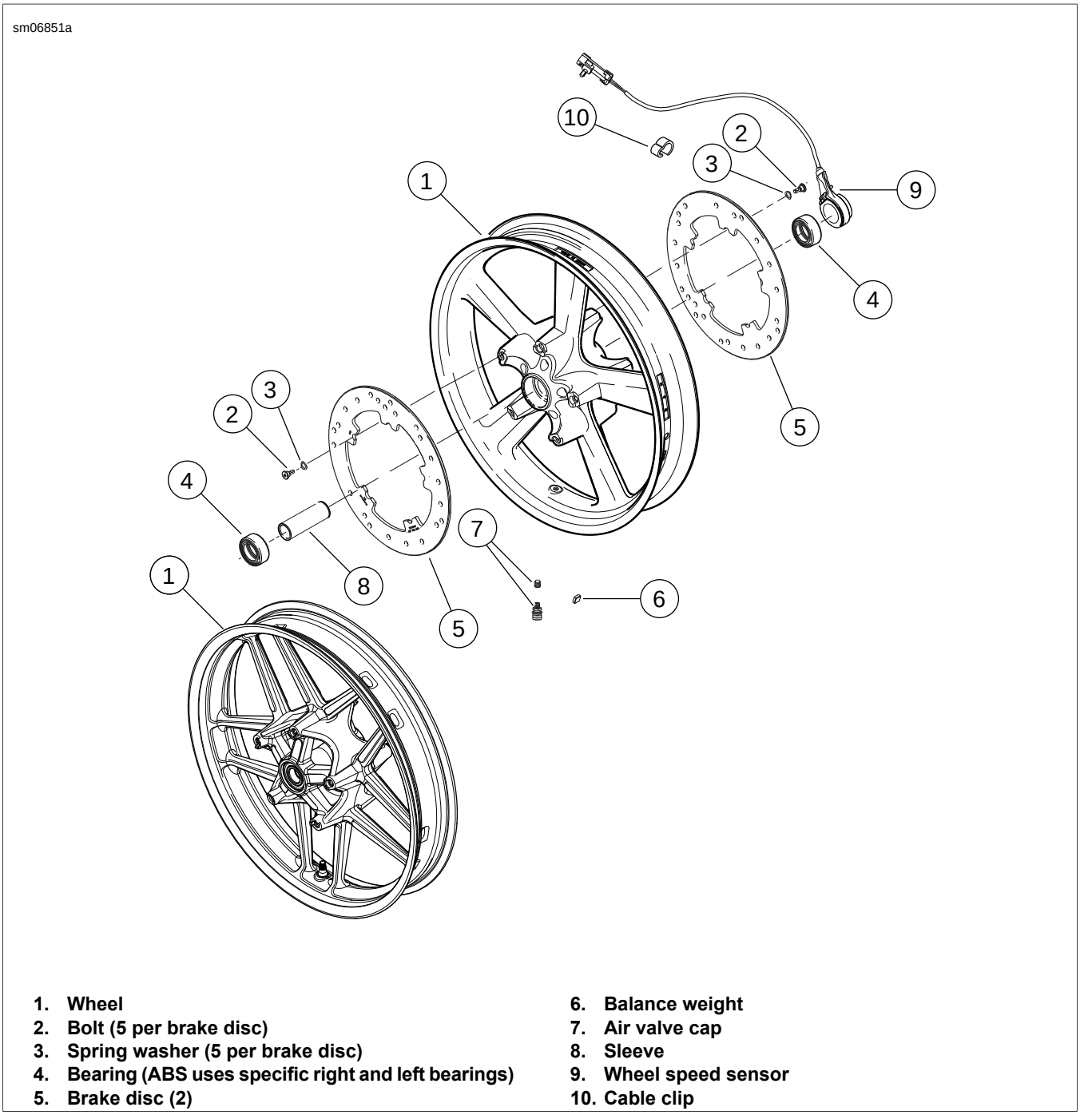
Preliminary Inspection - Brake Discs

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. If warped, replace disc. Maximum allowable lateral runout of a spring washer mounted brake disc is 0.2 mm (0.008 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Replace tire as necessary.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.27 SEALED WHEEL BEARINGS.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. **Wheel**
2. **Bolt (5 per brake disc)**
3. **Spring washer (5 per brake disc)**
4. **Bearing (ABS uses specific right and left bearings)**
5. **Brake disc (2)**
6. **Balance weight**
7. **Air valve cap**
8. **Sleeve**
9. **Wheel speed sensor**
10. **Cable clip**

Figure 2-50. Front Wheel Components

REMOVAL

1. Raise motorcycle with a suitable lifting device so front wheel is off the ground.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove right side cover and main fuse.
3. See Figure 2-51. On ABS models, release front wheel speed sensor cable from clip.
4. See Figure 2-52. Remove both upper and lower mounting bolts to remove brake caliper assembly.
5. Support calipers using a rubber bungee cord. Be careful not to scratch fender or fork slider finish.
6. Repeat to remove opposite caliper.



Figure 2-51. Front Wheel Speed Sensor Cable Clip (ABS Equipped)

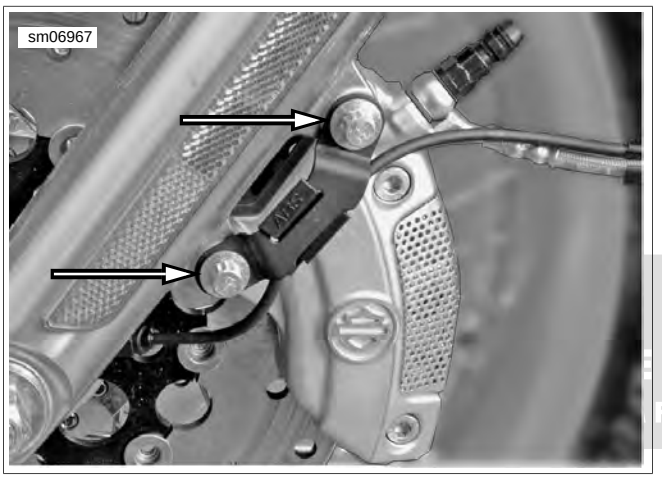


Figure 2-52. Caliper Mounting Bolts (typical, ABS model shown)

NOTE

Do not operate front brake lever with the front wheel removed or the caliper piston may be forced out of piston bore.

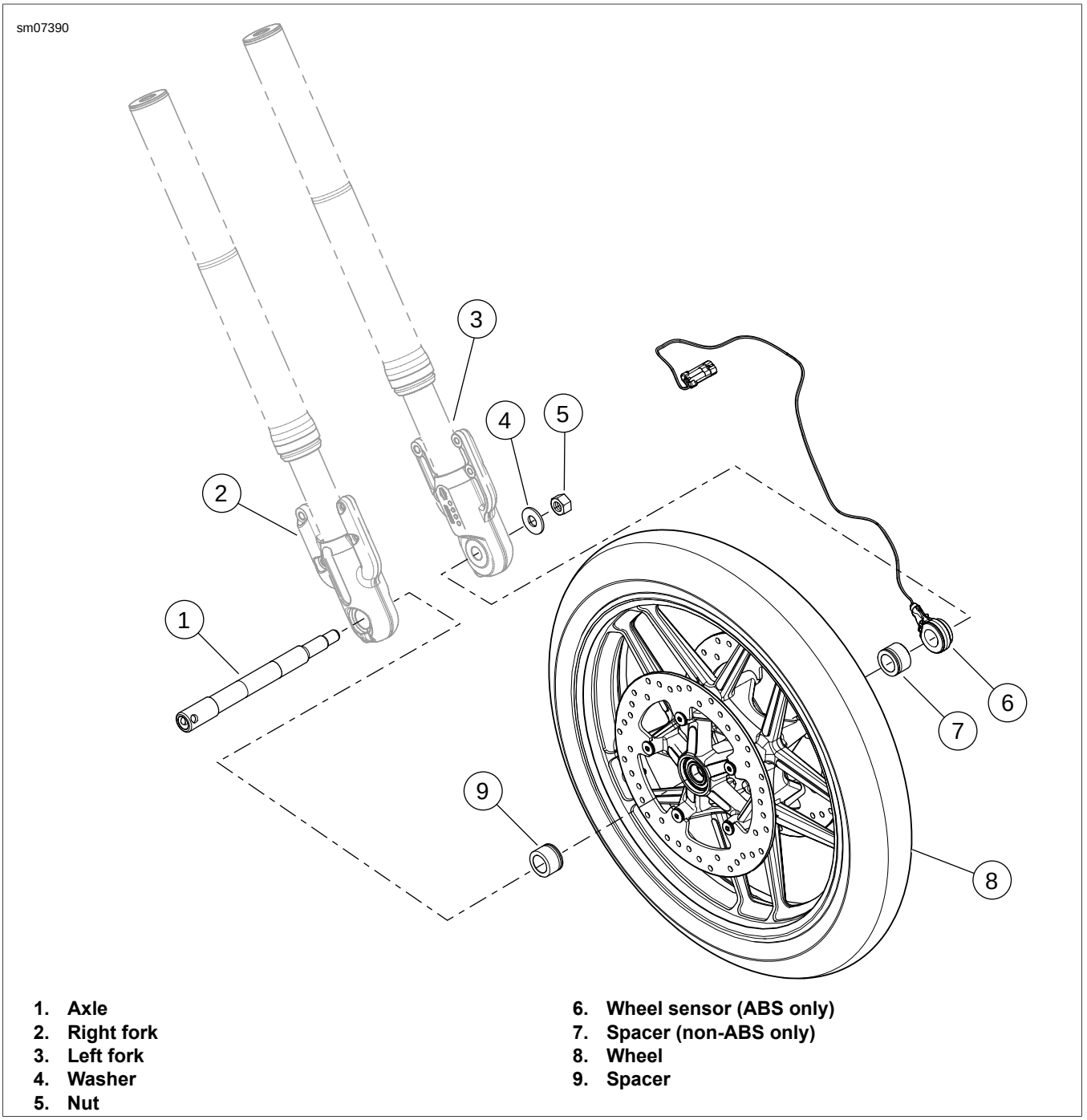
7. See Figure 2-53. Remove nut (5) and washer (4).

NOTES

- *On vehicles equipped with ABS, the left wheel spacer (7) is replaced by a wheel speed sensor (6).*
- *If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

8. Pull axle (1) out while retaining the left and right (9) wheel spacers.
9. Remove wheel assembly from forks.

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1. **Axle**
2. **Right fork**
3. **Left fork**
4. **Washer**
5. **Nut**
6. **Wheel sensor (ABS only)**
7. **Spacer (non-ABS only)**
8. **Wheel**
9. **Spacer**

Figure 2-53. Front Wheel

DISASSEMBLY

NOTE

See 2.29 TIRES to service tire or valve stem assembly.

1. Remove spacers from left and right sides.
2. If tire replacement is necessary, remove tire and valve stem. See 2.29 TIRES.
3. If wheel bearing replacement is necessary, remove the sleeve and press out the sealed wheel bearings. See 2.27 SEALED WHEEL BEARINGS.
4. If it is necessary to remove brake discs and if wheel is to be assembled with same discs, mark both wheel and discs, so they can be installed in their original locations.
5. See Figure 2-50. If removing brake discs (5), remove five bolts (2) and spring washers (3) securing brake disc to the wheel (1). Repeat procedure to remove disc on opposite side of wheel. Discard bolts and spring washers.

CLEANING AND INSPECTION

1. Thoroughly clean all parts (except wheel bearings, or wheel speed sensor if ABS equipped) in solvent. Wipe bearings or ABS sensors with damp cloth.

2. Inspect all parts for damage or excessive wear.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

3. Inspect brake discs. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc. Also replace discs if warped or badly scored. See 1.14 BRAKE PADS AND DISCS.

NOTE

Minimum thickness is measured from backing plate.

4. Inspect brake pads. Minimum brake pad thickness is 0.4 mm (0.016 in.).

ASSEMBLY

FASTENER	TORQUE VALUE	
Spring washers	22-33 Nm	16-24 ft-lbs
Brake disc bolts, front	22-23 Nm	16-24 ft-lbs

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

NOTE

Always install first of two bearings on the side opposite the valve stem side of the wheel.

1. If sealed wheel bearings must be serviced, always replace bearings as a complete set. See 2.27 SEALED WHEEL BEARINGS.

⚠WARNING

Be sure tires are properly inflated, balanced, undamaged, and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced, improperly inflated, overloaded or damaged tires can lead to tire failure and adversely affect stability and handling, which could result in death or serious injury. (00014b)

2. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.29 TIRES.

3. Verify that wheel and tire are true. See 2.29 TIRES and 2.28 CHECKING CAST WHEEL RUNOUT.

4. See Figure 2-50. If necessary, install brake discs in their original positions. Verify that brake discs are clean.
 a. On left side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach left brake disc. Tighten bolts to 22-33 Nm (16-24 ft-lbs).
 b. On right side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach right brake disc. Tighten bolts to 22-23 Nm (16-24 ft-lbs).

5. After wheel is balanced, apply a light coat of ANTI-SEIZE LUBRICANT to axle, bearing bores, and bore of inner sleeve.

NOTE

If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components. Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.

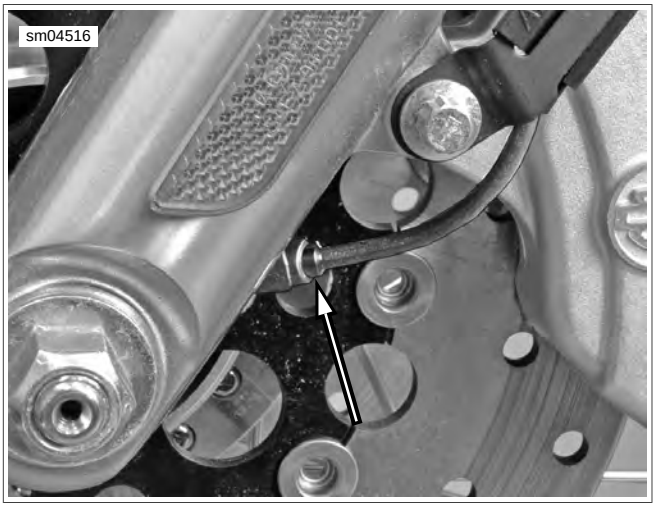
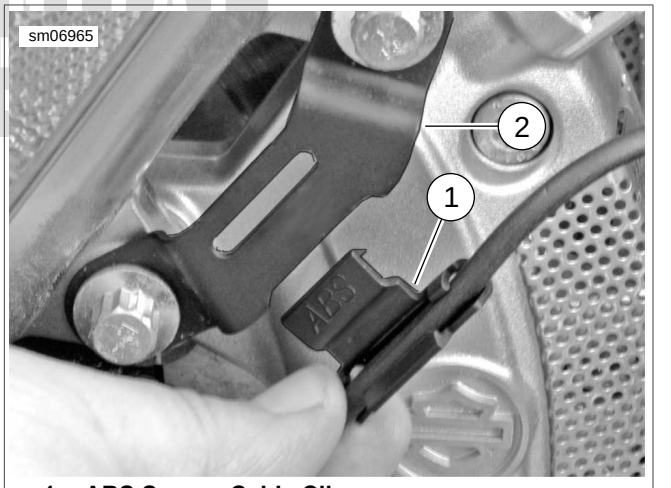


Figure 2-54. Front ABS Sensor Positioning



1. **ABS Sensor Cable Clip**
2. **ABS Sensor Cable Clip Bracket**

Figure 2-55. ABS Sensor Cable

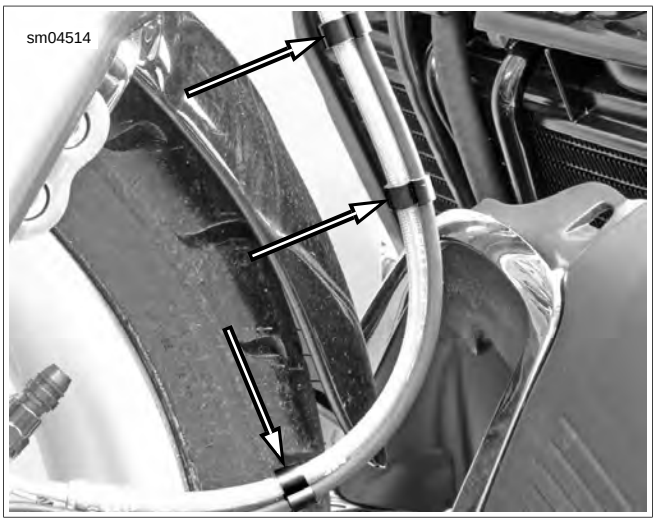


Figure 2-56. ABS Sensor Cable to Brake Hose Clips

INSTALLATION

FASTENER	TORQUE VALUE	
Front wheel axle nut	81-99 Nm	60-73 ft-lbs
Front axle pinch bolt	55-65 Nm	41-48 ft-lbs

NOTE

On vehicles equipped with ABS, the left wheel spacer (7) is replaced by a wheel speed sensor (6).

1. See Figure 2-53. Apply a light coat of ANTI-SEIZE LUBRICANT to axle (1).
2. Place wheel (8) and spacers into front forks (2, 3) and install axle (1). Verify that axle spacers on right and left side are properly installed. See C.3 WHEEL SPEED SENSOR.
3. Install washer (4) and thread on the axle nut (5). While holding axle stationary, tighten axle nut to 81-99 Nm (60-73 ft-lbs).
4. Tighten front axle pinch bolt to 55-65 Nm (41-48 ft-lbs).
5. Install the brake caliper to the fork legs. See 2.18 FRONT BRAKE CALIPER.
6. Repeat previous step to install brake caliper on other side of wheel.

⚠WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

7. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

8. Install main fuse and right side cover.

TECHNICIAN HARLEY-DAVIDSON

REAR WHEEL 2.26

GENERAL

Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. Wheels and tires should be inspected regularly for wear. If handling problems occur, see 1.26 TROUBLESHOOTING for possible causes.

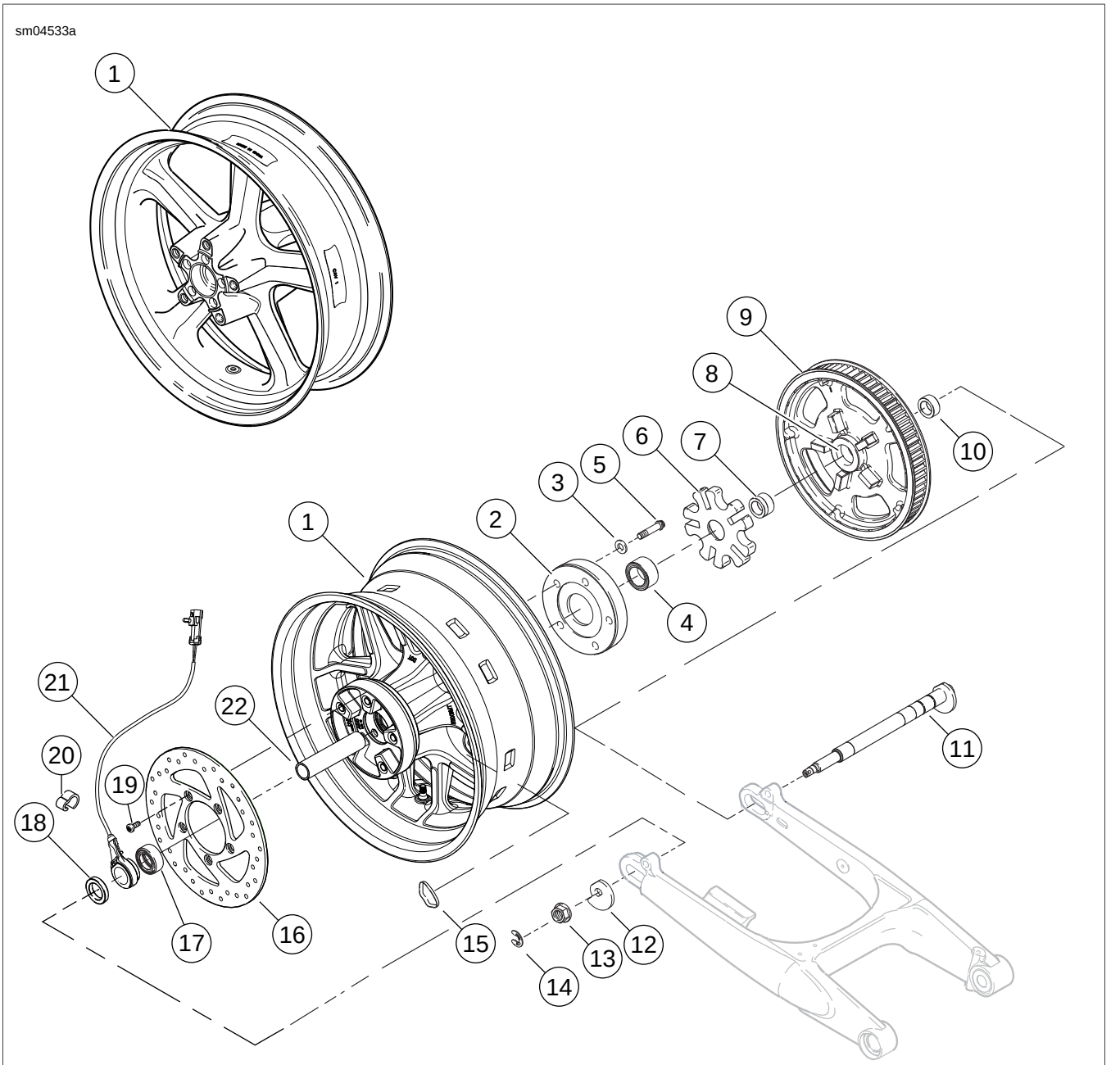
Preliminary Inspection - Brake Disc

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. Replace disc if warped. Maximum allowable runout of a rear brake disc is 0.2 mm (0.008 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so rear wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Remove wheel assembly and replace tire as necessary. See 2.29 TIRES.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.27 SEALED WHEEL BEARINGS.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. **Wheel (optional wheels shown)**
2. **Compensator bowl**
3. **Lockwasher (5)**
4. **Bearing (1 - ABS left side, 2 - NON-ABS right and left)**
5. **Screw (5)**
6. **Cushion compensator**
7. **Spacer**
8. **Bearing**
9. **Sprocket**
10. **Spacer - ABS**
11. **Axle**
12. **Rear axle adjuster**
13. **Nut**
14. **E-Clip**
15. **Plug (solid disc only) (5)**
16. **Brake disc**
17. **Bearing - ABS (right)**
18. **Spacer, wheel bearing**
19. **Screw (5)**
20. **Clip (4)**
21. **Wheel Speed Sensor - ABS**
22. **Sleeve Bearing**

Figure 2-57. Rear Wheel Components (typical)

REMOVAL

1. Raise motorcycle using a suitable lifting device underneath frame so weight of motorcycle is off rear wheel.

NOTE

A scissors style jack will allow the motorcycle to be raised or lowered at different points throughout the procedure to provide both clearance and alignment during removal and installation.

2. Remove right side cover and main fuse.

NOTE

VRSCF models only: *Remove lower shock bolts to provide clearance to remove axle.*

3. See Figure 2-58. Remove fasteners holding lower debris deflector (4) to rear fork. Remove debris deflector.
4. If necessary, remove fasteners holding belt guard (1) to rear fork. Back lower shock bolt (2) out until belt guard is free and remove belt guard. Shock bolt retaining threads are integral to belt guard. Leave shock bolt in place to maintain alignment.
5. See Figure 2-59. Remove snap ring (2), axle nut (1) and adjuster (4) from right side of axle.
6. Relieve belt tension by rotating axle adjusters.

NOTES

- *Support rear tire from underneath during removal. Failure to support rear tire may cause damage to the motorcycle as the axle is removed.*
- *If ABS equipped, carefully remove clips connecting ABS cable to brake hose.*
- *If ABS equipped, never pull wheel speed sensor cable taut, or use to retain wheel, axle, or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

7. Tap axle towards left side until rear brake caliper is free.
8. Slide rear caliper up off of brake disc towards front of motorcycle. Using a bungee cord, secure caliper to right side shock. Be sure rubber bumper stays with caliper.
9. Remove axle. Identify and set aside right and left spacers, right side axle adjuster, axle nut, and snap ring and ABS wheel speed sensor and ABS encoder bearing (if ABS equipped).

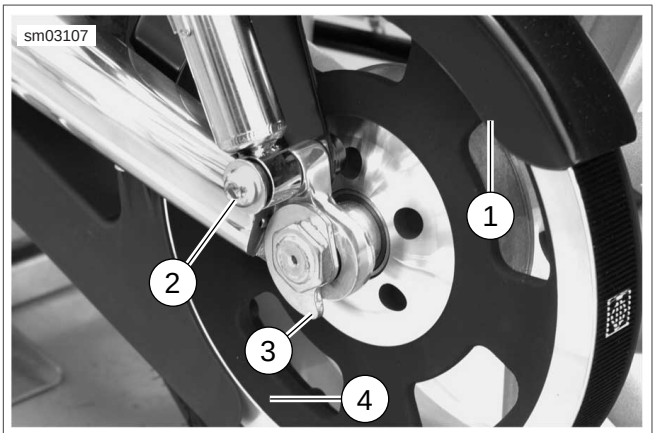
NOTE

Polished aluminum and painted wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

10. Move wheel forward and slip belt off sprocket. Adjust height of the scissors jack to allow removing wheel assembly without damaging components.
11. Pull wheel and drive belt sprocket assembly from rear fork.

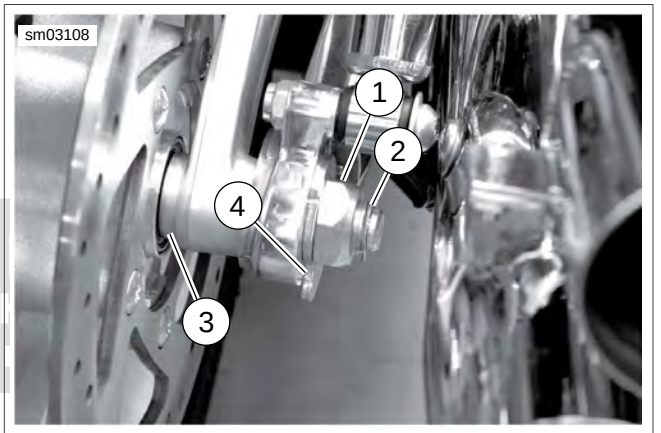
NOTE

Do not operate rear brake pedal with the rear wheel removed or the caliper piston may be forced out of piston bores. Seating the piston requires disassembly of the caliper.



1. **Belt guard**
2. **Lower shock bolt**
3. **Left side axle adjuster**
4. **Debris deflector**

Figure 2-58. Rear Axle: Left Side (typical)



1. **Axle nut**
2. **Snap ring**
3. **Right side spacer**
4. **Right side axle adjuster**

Figure 2-59. Rear Axle: Right Side (typical)

DISASSEMBLY

1. See Figure 2-65. Pull sprocket out of rubber compensator cushion (1) and compensator bowl (4) mounted to disc wheel.
2. Pull compensator spacer (2) and compensator cushion (1) from compensator bowl (4) mounted to disc wheel.
3. If tire replacement is necessary, remove tire and valve stem. See 2.29 TIRES.

NOTE

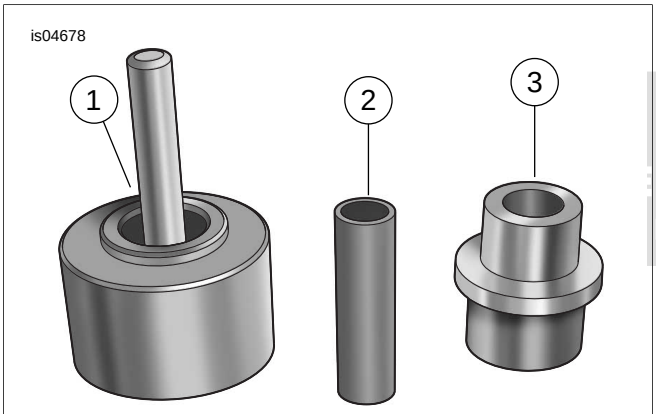
If drive sprocket bearing surface is rough or if bearing is leaking grease, replace bearing.

4. See Figure 2-57. If necessary, remove screws (5) and lockwashers (3) holding compensator bowl (2) to disc wheel (1). Remove compensator bowl (3).
5. If necessary, remove fasteners (19) that hold brake disc (16) to disc wheel (1) and remove brake disc (16).

CLEANING AND INSPECTION

PART NUMBER	TOOL NAME
HD-48921	REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER
HD-48921-2	BASE
HD-48921-3	DRIVER
HD-48921-4	SLEEVE

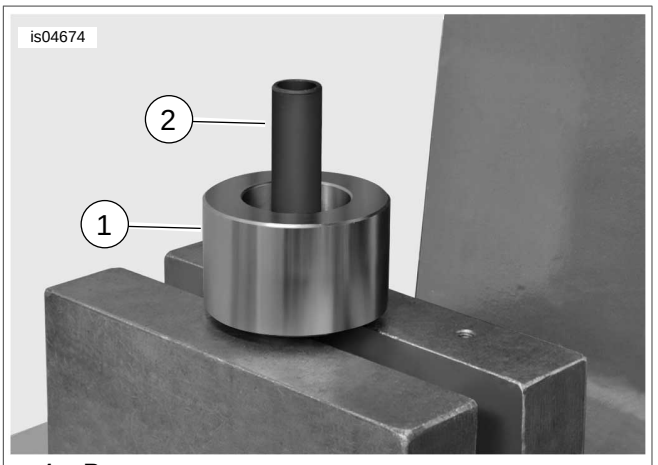
1. Thoroughly clean all parts (except wheel bearings, or wheel speed sensor if ABS equipped) in solvent. Wipe bearings or ABS sensors with damp cloth and inspect for wear.
2. Inspect drive belt. See 1.10 DRIVE BELT AND SPROCKETS.
3. Inspect sprocket bearing. If bearing surface is rough or if bearing was leaking grease, replace sprocket bearing as follows:
4. See Figure 2-60. Obtain the REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER (Part No. HD-48921).



1. **Base**
2. **Sleeve**
3. **Driver**

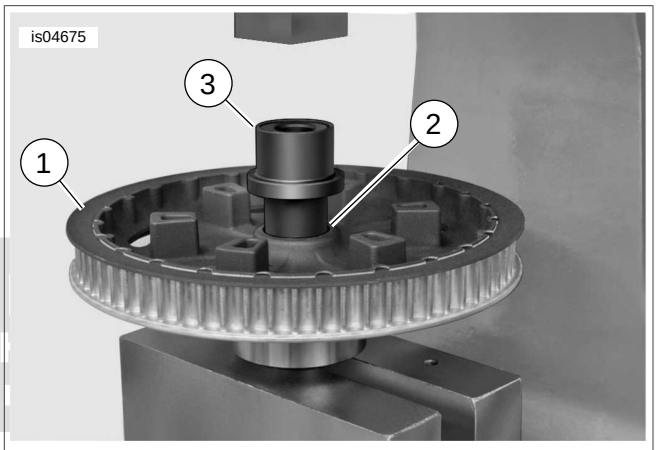
Figure 2-60. Rear Wheel Compensator Sprocket Bearing Remover/Installer (HD-48921)

5. Place parallel press blocks on deck of arbor press. Leave gap between press blocks to accommodate base pin in the next step.
6. See Figure 2-61. Position BASE (Part No. HD-48921-2) on press blocks with the large OD topside. Slide SLEEVE (Part No. HD-48921-4) over base pin.
7. See Figure 2-62. With the inboard side facing up, slide sprocket over sleeve until it rests on base. Slide small OD of DRIVER (Part No. HD-48921-3) over sleeve until contact is made with extended inner race of bearing.
8. Center arbor under ram and apply pressure until bearing drops into base. Disassemble tool and discard bearing.



1. **Base**
2. **Sleeve**

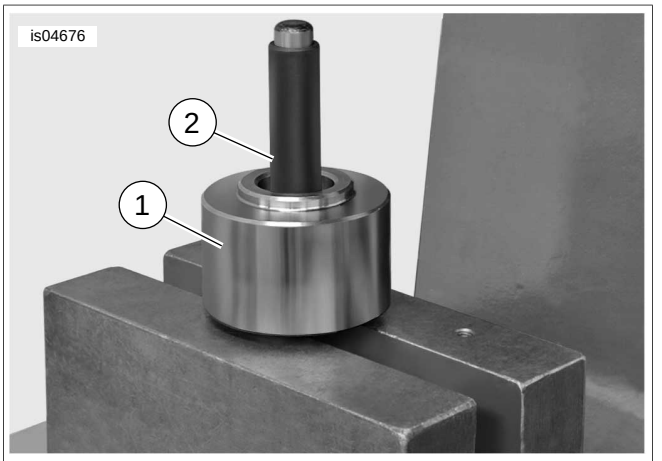
Figure 2-61. Base and Sleeve Set for Bearing Removal



1. **Sprocket**
2. **Bearing inner race**
3. **Driver**

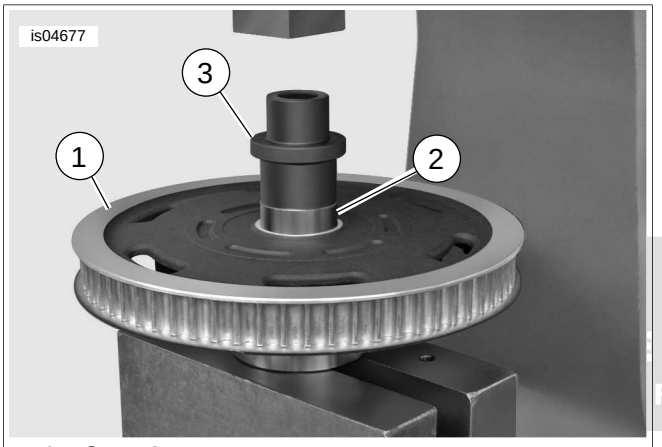
Figure 2-62. Remove Compensator Sprocket Bearing

9. Obtain the REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER (Part No. HD-48921).
10. See Figure 2-63. Position BASE (Part No. HD-48921-2) on deck of arbor press with the small OD topside. Slide SLEEVE (Part No. HD-48921-4) over the pin base.
11. Verify that sprocket bearing bore is clean and dry.
12. See Figure 2-64. With the outboard side facing up, slide sprocket over sleeve until it rests on base. Slide bearing over sleeve with the extended inner race down. Slide large OD of DRIVER (Part No. HD-48921-3) over sleeve until contact is made with outer race of bearing.
13. Center driver under ram and apply pressure until bearing makes firm contact with counterbore in sprocket. Disassemble tool.
14. Turn sprocket over and verify that bearing is fully seated.



1. **Base**
2. **Sleeve**

Figure 2-63. Base and Sleeve Set for Bearing Installation



1. **Sprocket**
2. **Bearing outer race**
3. **Driver**

Figure 2-64. Install Compensator Sprocket Bearing

15. Inspect compensator cushion for missing chunks or excessive debris beyond normal wear marks. Replace if necessary.
16. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
17. If sealed wheel bearings must be serviced, see 2.27 SEALED WHEEL BEARINGS.

⚠WARNING

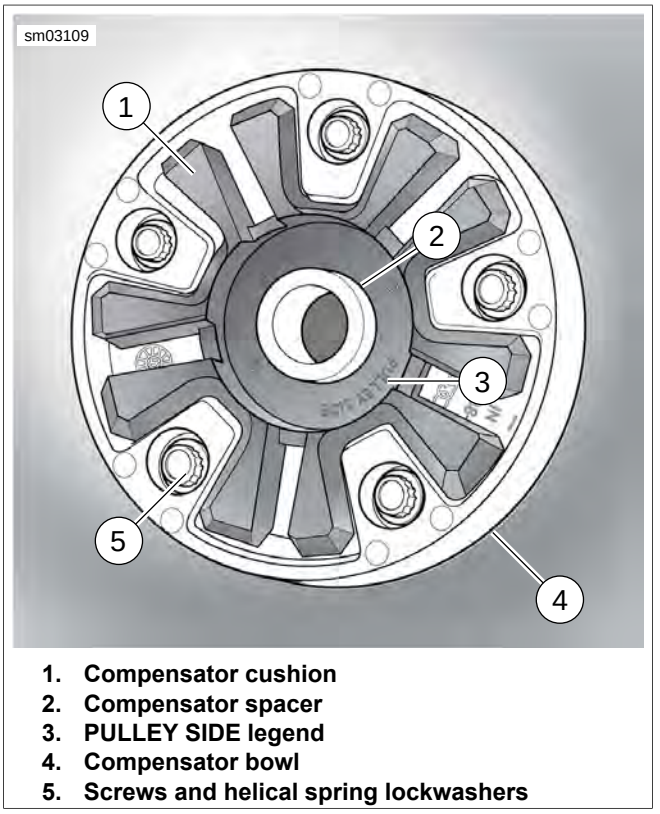
Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

18. Inspect brake pads, calipers, and brake lines. Replace pads and service calipers and brake lines as required. See 1.14 BRAKE PADS AND DISCS.

ASSEMBLY

FASTENER	TORQUE VALUE	
Brake disc bolts, rear	41-53 Nm	30-38 ft-lbs
Compensator bowl screws (initial torque)	75-88 Nm	55-65 ft-lbs
Compensator bowl screws (final torque)	102-115 Nm	75-85 ft-lbs

1. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.29 TIRES.
2. Install brake disc, if removed, on valve stem side of wheel.
 a. Install **new** bolts that hold on rear brake disc.
 b. Install and alternately tighten bolts to 41-53 Nm (30-38 ft-lbs).
3. Install compensator bowl using **new** screws. Thread in screws with helical spring lockwashers. Tighten to 75-88 Nm (55-65 ft-lbs), break away and back off one half turn and final tighten to 102-115 Nm (75-85 ft-lbs).
4. Verify that wheel and tire are true and balanced. See 2.28 CHECKING CAST WHEEL RUNOUT and 2.29 TIRES.
5. After wheel is balanced, apply ANTI-SEIZE LUBRICANT to entire surface of left side (compensator bowl) bearing race only.
6. See Figure 2-65. Lubricate compensator cushion (1) with a detergent spray like glass cleaner and install compensator cushion. Be sure the PULLEY SIDE legend (3) is facing out.
7. Install the compensation spacer (2) with the grooved end in the cushion (1).
8. Insert sprocket dogs into compensator cushion to mate sprocket to rear wheel.



1. **Compensator cushion**
2. **Compensator spacer**
3. **PULLEY SIDE legend**
4. **Compensator bowl**
5. **Screws and helical spring lockwashers**

Figure 2-65. Compensator Cushion in Compensator Bowl (typical)

INSTALLATION

FASTENER	TORQUE VALUE	
Rear axle nut	190-203 Nm	140-150 ft-lbs
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**

1. Install wheel into rear fork.
2. Slide drive belt over drive sprocket.
3. Slide brake calipers over front brake disc between brake pads. Lubricate rubber bumper with a detergent spray and slide slot in the caliper over brake anchor weldment on rear fork. Be sure rubber bumper is in place under weldment.
4. Apply a light coat of ANTI-SEIZE LUBRICANT to axle, bearing bores, bore of left spacer, bore of brake caliper mount, and bore of inner sleeve. **ABS MODELS:** See 1.10 DRIVE BELT AND SPROCKETS.
 a. From left side, carefully insert axle through rear fork, left side spacer, drive sprocket, compensator cushion, into wheel assembly.
 b. Continue sliding axle through wheel assembly hub sleeve, right side spacer, brake caliper, and left rear fork. Center right side spacer on wheel bearing to allow axle to pass through. Axle is fully installed when left side cam is tight against rear fork.
 c. Slip on right side axle adjuster. Right side axle adjuster will only fit in a manner that matches position of left side eccentric.
 d. Coat flange of axle nut with GRADE ANTI-SEIZE 98960-97 and thread on and finger tighten axle nut.

⚠WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

NOTES

- *If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

5. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
6. Verify axle alignment and then check belt deflection. See 1.10 DRIVE BELT AND SPROCKETS.
7. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling and can cause loss of control, which could result in death or serious injury. (00285b)

8. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
9. Install snap ring.

NOTE

On VRSCF Models: *Install right side lower shock bolt.*

10. If belt guard was removed, slide belt guard slots onto rubber grommets. Install shock mount bolt into belt guard. See 2.36 REAR SHOCK ABSORBERS.
11. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector bolt and tighten bolt to 6-10 Nm (53-88 **in-lbs**).
12. Measure belt guard to drive sprocket clearance. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.

13. Install main fuse and right side cover.

SEALED WHEEL BEARINGS 2.27

GENERAL

Inspection for lateral end play, removal, and installation procedures for sealed wheel bearings are the same for both the front wheel and the rear wheel.

INSPECTION: LATERAL END PLAY

1. Block motorcycle underneath frame so wheel is raised off ground.

NOTE

If ABS equipped, keep magnetic base dial indicator as far away from wheel speed sensor and ABS encoder bearing as possible, or damage will occur.

2. See Figure 2-66. Mount a magnetic base dial indicator to brake disc with dial's contact point on end of axle.

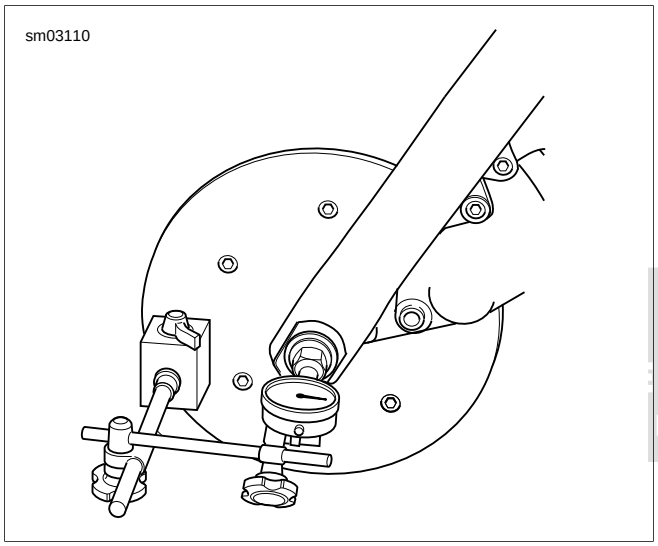


Figure 2-66. Measuring Lateral End Play (Front Wheel) (typical)

3. To check for lateral end play, turn wheel through several rotations, then move wheel side to side.
 a. If end play is less than service wear limit of 0.051 mm (.002 in.), bearing passes inspection.
 b. If end play exceeds service wear limit or feels rough, remove wheel and replace both wheel bearings.

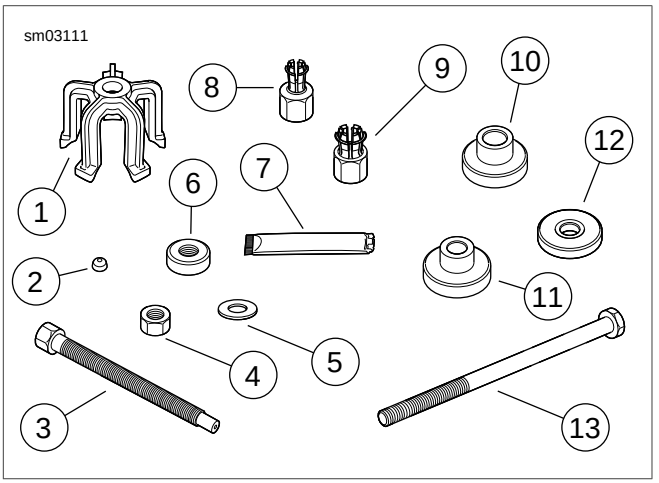


Figure 2-67. HD-44060 Wheel Bearing Tools (See Table)

Table 2-10. HD-44060 Wheel Bearing Tools

NO.	DESCRIPTION	PART NO.
1	Bridge	HD-44060-5
2	Steel ball	12547
3	Forcing screw	HD-44060-4
4	Nut	10210
5	Washer	12004
6	Bearing	RS25100-200
7	Lubricant	J-23444A
8	Collet, 3/4 in.	HD-44060-3
9	Collet, 1.0 in.	HD-44060-7
10	Pilot, 1.0 in.	HD-44060-8
11	Pilot, 3/4 in.	HD-44060-6
12	Support plate	HD-44060-1
13	Threaded rod	280856
Parts 1-7 common to removal/installation.		
Parts 8-9 used for removal only.		
Parts 10-13 used for installation only.		

REMOVAL

PART NUMBER	TOOL NAME
HD-44060C	WHEEL BEARING INSTALLER/REMOVER

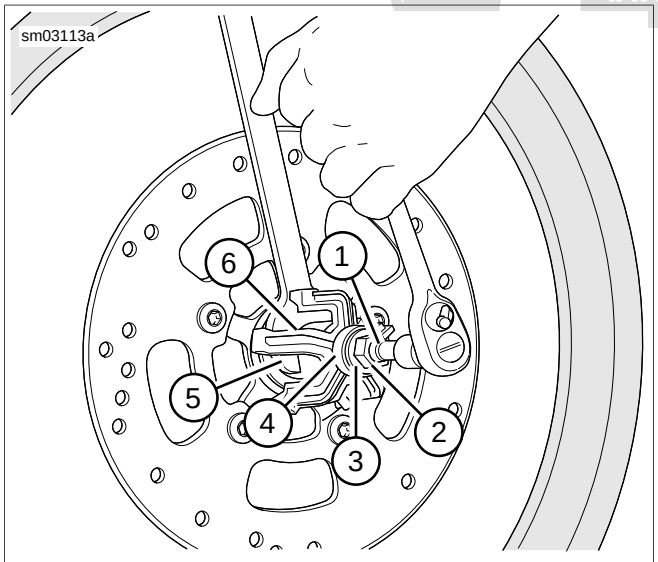
1. Remove wheel. See 2.26 REAR WHEEL or 2.25 FRONT WHEEL.

2. See Figure 2-68. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060C) and assemble tools required for bearing removal.
 a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and enable smooth operation.
 b. Install nut (2), washer (3) and bearing (4) on screw. Insert assembly through hole in bridge (6).

 NOTE

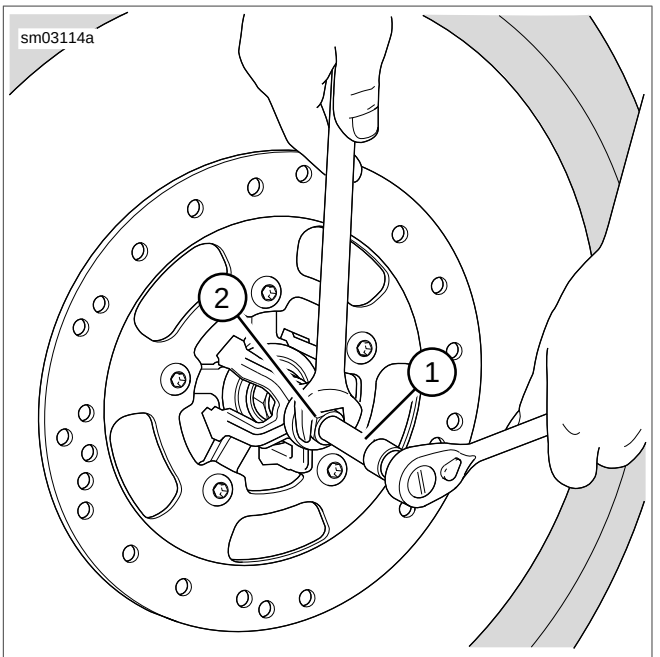
 As ABS equipped motorcycles use both a special encoder bearing and a standard bearing in the same hub, two different 25 mm collets are required for bearing removal. The ABS encoder bearing is always installed on the primary brake disc side of the wheel. To aid in identification, the outboard side of the ABS encoder bearing is greenish tan in color, while the standard bearing is black.

 c. Drop ball bearing inside collet (5). Fasten collet and ball bearing to forcing screw (1).
3. Hold end of forcing screw (1) and turn collet (5) to expand edges of collet.
4. See Figure 2-69. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn nut (2) to remove bearing from wheel.
5. If ABS encoder bearing was removed from primary brake disc side of wheel, remove ABS collett from forcing screw and install standard collett.
6. Remove spacer from inside wheel hub.
7. Repeat procedure for opposite side bearing. Discard all bearings upon removal.



1. **Forcing screw**
2. **Nut**
3. **Washer**
4. **Bearing**
5. **Collet with ball bearing inside**
6. **Bridge**

Figure 2-68. Gripping Bearing



1. **Forcing screw**
2. **Nut**

Figure 2-69. Removing Bearing

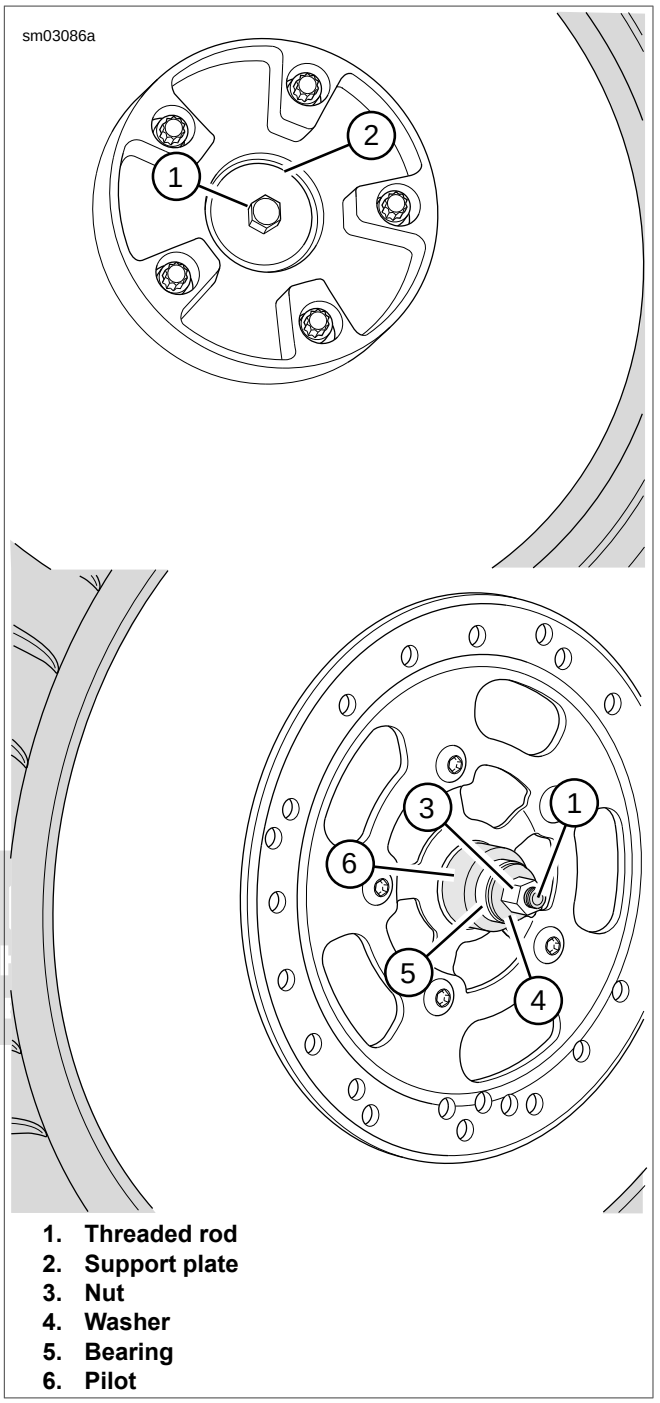
INSTALLATION

PART NUMBER	TOOL NAME
HD-44060C	WHEEL BEARING INSTALLER/REMOVER

NOTES

- *On a front wheel, install bearing on the left side first. On a rear wheel, install bearing on the brake disc or right side first. On ABS equipped motorcycles, the special encoder bearing is always installed at this location.*
- *As ABS equipped motorcycles use both a special encoder bearing and a standard bearing in the same hub, two different 25 mm collets are required for bearing removal. The ABS encoder bearing is always installed on the primary brake disc side of the wheel. To aid in identification, the outboard side of the ABS encoder bearing is greenish tan in color, while the standard bearing is black.*

1. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060C) and assemble tools required for bearing installation.
 a. Sparingly apply graphite lubricant to threads of a draw down bolt or a suitable threaded rod with double locking nuts to prolong service life and ensure smooth operation.
 b. See Figure 2-70. Place threaded rod (1) through support plate (2).
 c. Insert assembly through wheel.
 d. Place the **new** bearing on threaded rod (1) with lettered side outward. If ABS equipped, slide encoder bearing down rod with red-side in and greenish tan-side out.
 e. Install pilot (6), bearing (5), washer (4) and nut (3) over rod.
2. Hold hex end of threaded rod (1) and turn nut (3) to install bearing. Bearing will be fully seated when nut can no longer be turned. Remove tool.
3. Install spacer sleeve inside wheel hub.
4. Reverse tool and install opposite side bearing.



1. **Threaded rod**
2. **Support plate**
3. **Nut**
4. **Washer**
5. **Bearing**
6. **Pilot**

Figure 2-70. Installing Wheel Bearing

CHECKING CAST WHEEL RUNOUT 2.28

CHECKING WHEEL RUNOUT

PART NUMBER	TOOL NAME
HD-99500-80	WHEEL TRUING AND BALANCING STAND

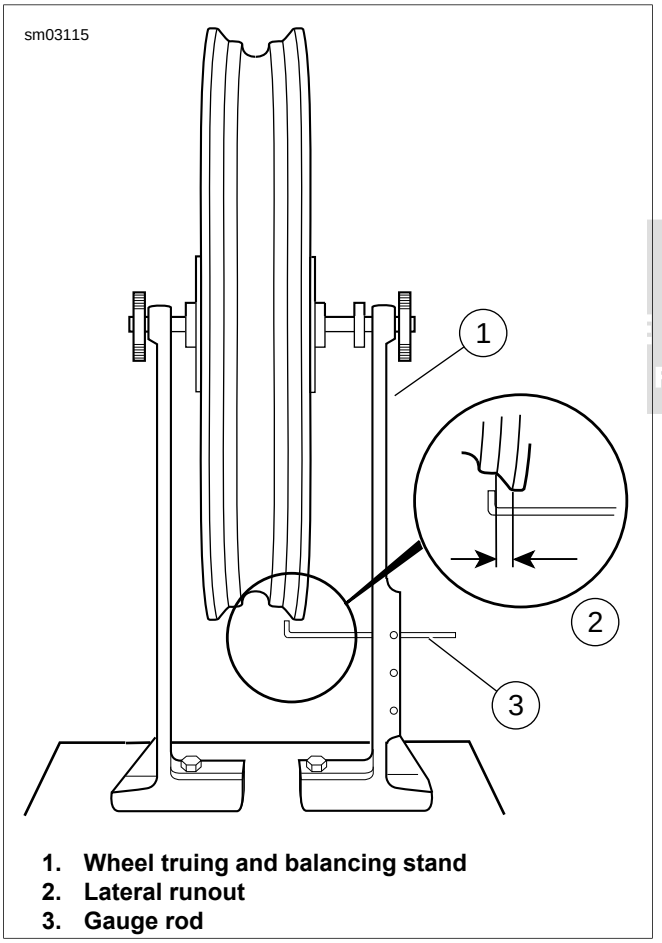
Checking Lateral Runout

See Figure 2-71. Mount wheel in WHEEL TRUING AND BALANCING STAND (Part No. HD-99500-80).

NOTE

To more accurately measure runout, a dial indicator can be used in place of the gauge rod.

To check lateral runout, place a gauge rod near, or dial indicator on the rim bead flange and measure distance at several locations. Lateral runout must not exceed 0.76 mm (0.030 in).

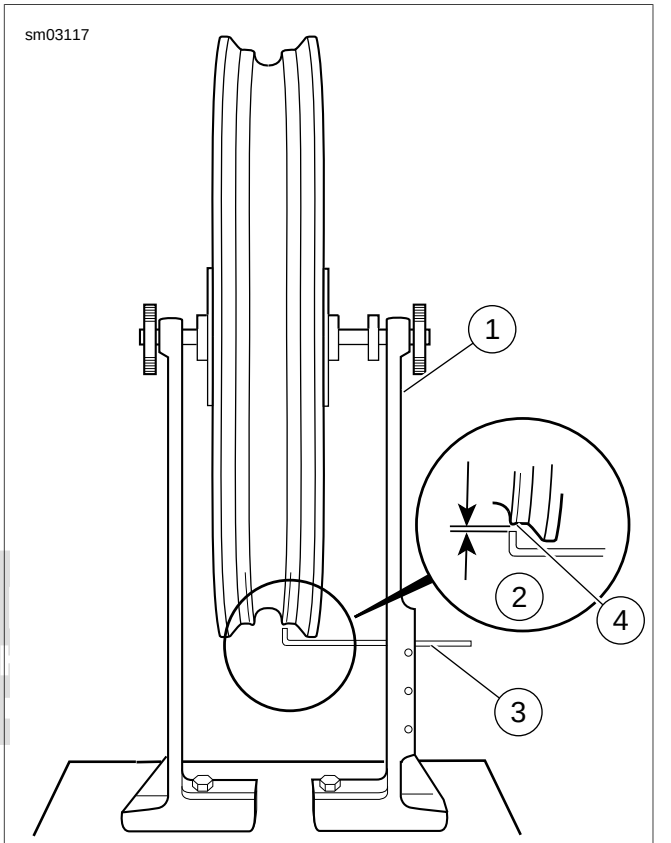


1. **Wheel truing and balancing stand**
2. **Lateral runout**
3. **Gauge rod**

Figure 2-71. Checking Lateral Runout

Checking Radial Runout

See Figure 2-72. Adjust truing stand gauge to the rim's tire bead safety hump. Rotate wheel and measure distance at several locations. Runout must not exceed 0.76 mm (0.030 in). If either measurement is not within specification, replace wheel.



1. **Wheel truing and balancing stand**
2. **Radial runout**
3. **Gauge rod**
4. **Bead safety hump**

Figure 2-72. Checking Radial Runout

TIRES 2.29

GENERAL

⚠WARNING

Use only Harley-Davidson specified tires. See a Harley-Davidson dealer. Using non-specified tires can adversely affect stability, handling or braking, which could result in death or serious injury. (00024b)

⚠WARNING

Be sure tires are properly inflated, balanced, undamaged, and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced, improperly inflated, overloaded or damaged tires can lead to tire failure and adversely affect stability and handling, which could result in death or serious injury. (00014b)

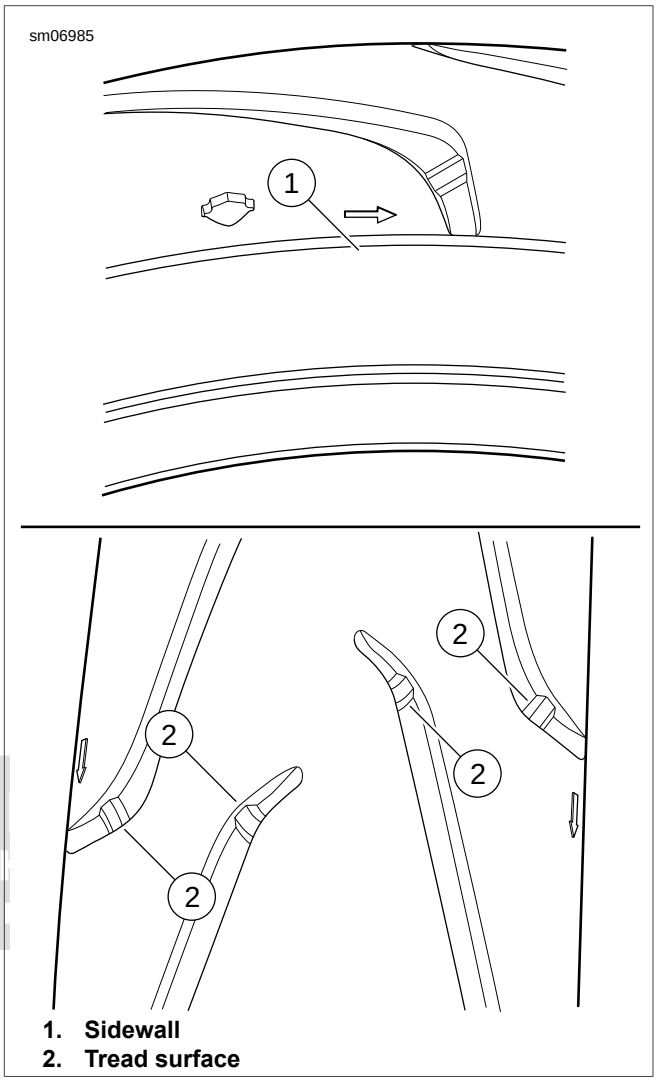
Always maintain proper tire pressure as specified in Table 2-5. Do not load tires beyond GAWR specified in Table 2-2. Under-inflated, over-inflated or overloaded tires can fail.

NOTES

- *Check runout on all wheels before installing a **new** tire. See 1.8 TIRES AND WHEELS.*
- *Store **new** tires on a horizontal tire rack. Avoid stacking **new** tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.*
- *Inspect tires for punctures, cuts, breaks and wear at least weekly.*
- *See Figure 2-73. The tread wear indicator bars will appear on tire tread surfaces when 0.8 mm (1/32 in) or less of tread remains. Always remove tires from service before they reach the tread wear indicator bars.*

New tires are needed if any of the following conditions exist. See 1.8 TIRES AND WHEELS.

1. Tire wear indicator bars are visible on the tread surfaces.
2. Tire cords or fabric are visible through cracked sidewalls, snags or deep cuts.
3. A bump, bulge or split in the tire.
4. Puncture, cut or other damage to the tire that cannot be repaired.



1. Sidewall
2. Tread surface

Figure 2-73. Tread Wear Indicators (typical)

REMOVAL

NOTE

Take care when removing and installing tire to prevent cosmetic damage to wheel. This is especially true with wheels that feature painted surfaces.

1. Remove wheel from motorcycle:
 a. **Front wheel:** See 2.25 FRONT WHEEL, Removal.
 b. **Rear wheel:** See 2.26 REAR WHEEL, Removal.
2. Deflate tire.

NOTE

On tube type wheels, it is not necessary to completely remove tire from rim to replace the tube only. Removing one side allows the tube to be replaced and allows for inspection of tire.

3. Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to loosen the beads from the rim.

4. Remove tire.

CLEANING, INSPECTION, AND REPAIR

1. Clean the inside of tire.
2. If rim is dirty, clean with a stiff wire brush.
3. Wheels should be checked for lateral and radial runout before installing a **new** tire. See 2.28 CHECKING CAST WHEEL RUNOUT.
4. Inspect the tire for wear and damage. Inspect tread depth. Replace worn tires.

⚠WARNING

Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the removed tire by a Harley-Davidson dealer. Speed should NOT exceed 50 mph (80 km/h) for the first 24 hours after repair, and the repaired tire should NEVER be used over 80 mph (130 km/h). Failure to follow this warning could lead to tire failure and result in death or serious injury. (00015b)

5. Tubeless tires may be repaired in the tread area only if the puncture is 6.4 mm (1/4 in.) or smaller. All repairs must be made from inside the tire.
6. Acceptable repair method involves the use of a patch and plug combination.

INSTALLATION

FASTENER	TORQUE VALUE	
Valve stem nut	1.4-1.7 Nm	12-15 **in-lbs**

⚠WARNING

Match tires, tubes, rim strips or seals, air valves and caps to the correct wheel. Contact a Harley-Davidson dealer. Mismatching can lead to tire damage, allow tire slippage on the wheel or cause tire failure, which could result in death or serious injury. (00023c)

⚠WARNING

Harley-Davidson front and rear tires are not the same. Interchanging front and rear tires can cause tire failure, which could result in death or serious injury. (00026a)

⚠WARNING

Do not exceed manufacturer's recommended pressure to seat beads. Exceeding recommended bead seat pressure can cause tire rim assembly to burst, which could result in death or serious injury. (00282a)

⚠WARNING

Be sure tires are properly inflated, balanced, undamaged, and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced, improperly inflated, overloaded or damaged tires can lead to tire failure and adversely affect stability and handling, which could result in death or serious injury. (00014b)

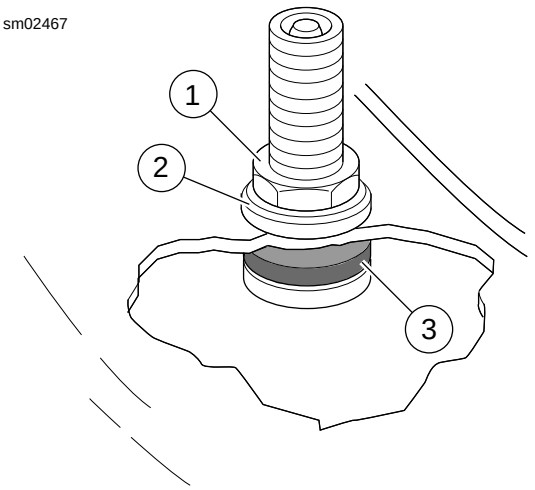
NOTES

- *For correct tire and tube types, see 2.2 SPECIFICATIONS: CHASSIS.*
- *Some tires have arrows molded into the tire sidewall. These tires should be mounted on the rim with the arrow pointing in the direction of forward rotation. The colored dot on the sidewall is a balance mark and should be located next to the valve stem hole.*

⚠WARNING

Only install original equipment tire valves and valve caps. A valve, or valve and cap combination, that is too long or too heavy can strike adjacent components and damage the valve, causing rapid tire deflation. Rapid tire deflation can cause loss of vehicle control, which could result in death or serious injury. (00281a)

1. See Figure 2-74. On tubeless wheels, damaged or leaking valve stems must be replaced. Install rubber grommet (3) on valve stem.
2. Insert valve stem into rim hole.
3. Install metal washer (2).
4. Install nut and tighten to 1.4-1.7 Nm (12-15 **in-lbs**).
5. Install tire.



1. **Nut**
2. **Metal washer**
3. **Rubber grommet**

Figure 2-74. Tubeless Tire Valve Stem

CHECKING TIRE RUNOUT

Lateral Runout

1. Verify that the tire is inflated to the proper pressure.
2. See Figure 2-75. Turn the wheel on the axle and measure tire lateral runout from a fixed point to a smooth area on the tire sidewall. Avoid measuring on raised letters or vents.
3. Tire lateral runout should not exceed 2.29 mm (0.090 in). If tire runout exceeds specification, remove tire from rim and check rim lateral runout. See 2.28 CHECKING CAST WHEEL RUNOUT.
4. If rim lateral runout is within specification, the tire is at fault and must be replaced. If rim lateral runout is not within specification, replace cast wheel.
5. Install the tire and recheck tire lateral runout.

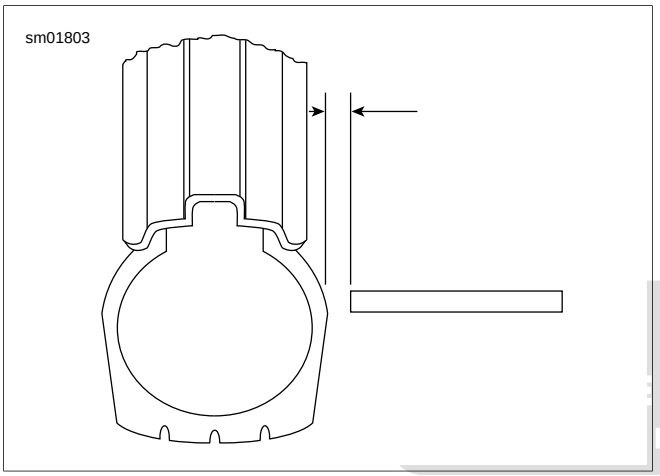


Figure 2-75. Checking Tire Lateral Runout

Radial Runout

1. Verify that the tire is inflated to the proper pressure.
2. See Figure 2-76. Turn the wheel on the axle and measure tire radial runout at the tread centerline.
3. Tire radial runout should not exceed 2.29 mm (0.090 in). If tire runout exceeds this specification, remove tire from rim. and check rim radial runout. See 2.28 CHECKING CAST WHEEL RUNOUT.
4. If rim radial runout is within specification, the tire is at fault and must be replaced. If rim bead radial runout is not within specification, replace cast wheel.
5. Install the tire and recheck tire radial runout.

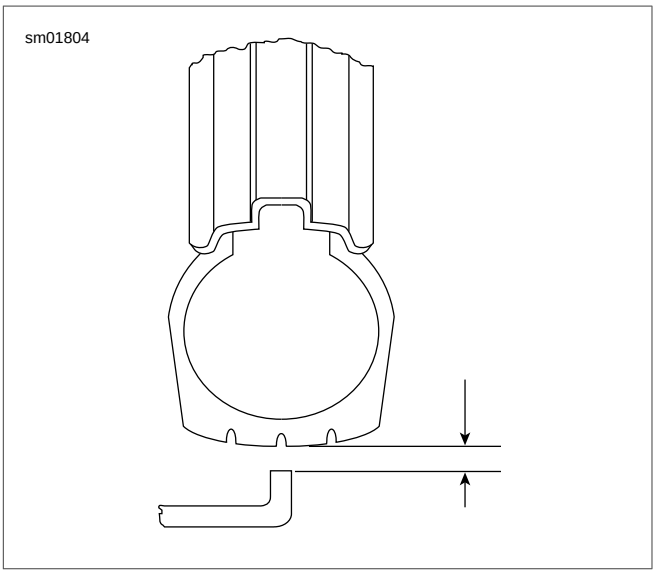


Figure 2-76. Checking Tire Radial Runout

WHEEL BALANCING

Static vs Dynamic

Wheel balancing is recommended to improve handling and to reduce vibration, especially at high road speeds.

Static balancing will produce satisfactory results for normal highway speeds. Dynamic balancing can produce better results for high speed operation.

Weights

The maximum weight permissible to accomplish balance is 99.2 g (3.5 oz) (total weight applied to the rim). If more than 99.2 g (3.5 oz) of weight is required, rotate the tire 180 degrees on the rim and again balance the assembly. Balance wheels to within 14 g (0.5 oz).

All wheel weights currently supplied by Harley-Davidson are made from zinc which is lighter than lead. The weight of each zinc segments is 5 g (0.18 oz) as compared to 7 g (0.25 oz) for lead and is stamped into each segment for easy identification. Consider this difference when balancing wheels.

NOTES

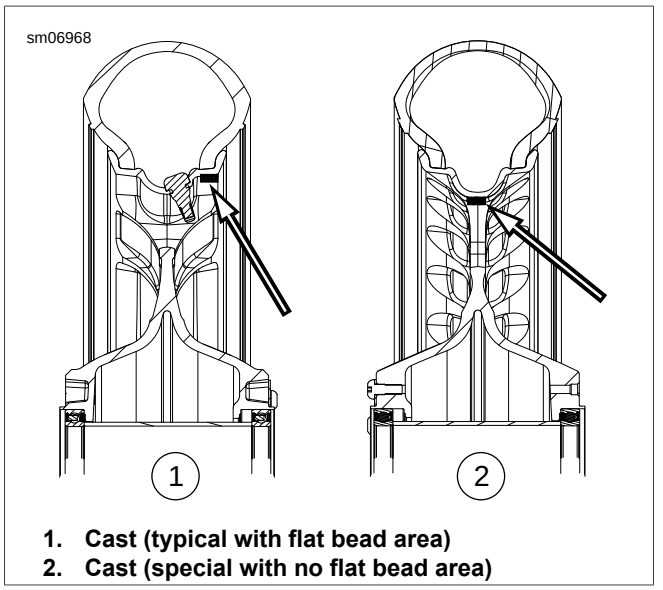
- *If adding more than 43 g (1.5 oz) of weight at one location, divide the amount so that half is applied to each side of rim.*
- *On cast wheels without a flat area near the bead, place them crosswise through the opening.*

1. See Figure 2-77. Place weights on a smooth surface of the wheel rim such that centrifugal force will help keep them in place. Make sure the area of application is completely clean, dry, and free of oil and grease.

NOTE

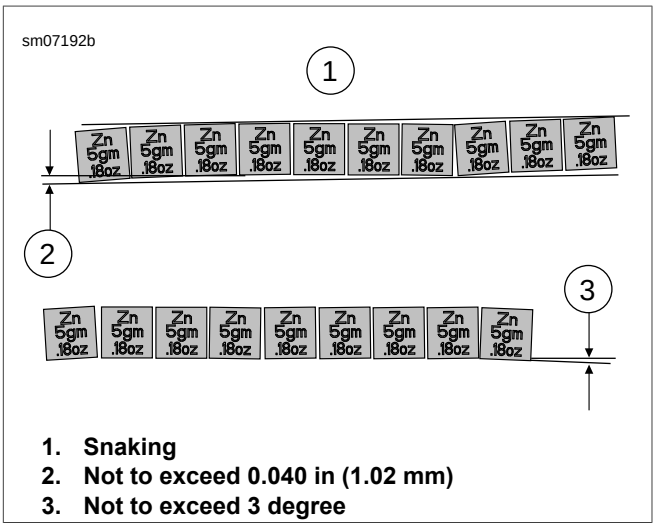
See Figure 2-78. When installing wheel weights, consider cosmetics. Keep snaking (1) within 1.02 mm (0.040 in) (3) of straight. Also keep the angle alignment of individual segments (2) within 3 degrees.

2. Remove paper backing from the weight. Press firmly in place and hold for ten seconds.



1. Cast (typical with flat bead area)
2. Cast (special with no flat bead area)

Figure 2-77. Wheel Weight Placement



1. Snaking
2. Not to exceed 0.040 in (1.02 mm)
3. Not to exceed 3 degree

Figure 2-78. Weight Segment Alignment

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WHEEL ALIGNMENT 2.30

GENERAL

The alignment of the front wheel to the rear wheel is set at the factory. There are no adjustments for alignment. Alignment is maintained with quality components and with correct assembly procedures.

The stabilizer link between the engine and the frame is a horizontal engine locator only. The stabilizer link is **not** to be used to adjust the horizontal alignment of the rear wheel. See 2.6 FRONT ENGINE MOUNT ASSEMBLY.

Verification of front wheel to rear wheel alignment can be used to determine the cause of an ill-handling motorcycle or of a vibration/noise in the front engine mount.

INSPECTION

Inspect:

- Before following the verification procedure.
- After engine removal and replacement.
- After service that requires removing and replacing the front motor mounts.
- After service that requires removing and replacing he rear fork and engine mounts.

Inspect for:

- Front and rear engine mount integrity.
- Stabilizer link integrity.
- Rear tire to fender mounting hardware clearance.
- Lower left crankcase to frame rail clearance.

Front Engine Mount

1. Verify condition and torque of the front engine mount. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Replace the rubber mount if there are any signs of bulging, cracking, or shearing. See 2.5 FRONT ENGINE MOUNT.

Rear Engine Mounts and Rear Fork Pivot

1. Verify condition and torque of the mounting hardware. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Examine rubber rear engine mounts to be sure there is no twisting or binding. Replace as required. See 2.7 REAR ENGINE MOUNTS.

Engine Stabilizer Link

1. Verify condition and torque of the mounting hardware.
2. Visually inspect for wear, damage or improper installation. Replace hardware as necessary. See 2.6 FRONT ENGINE MOUNT ASSEMBLY.

Clearances

1. The rear wheel and tire must have adequate clearance through its suspension travel.
2. The engine crankcase should have a minimum 3.18 mm (0.125 in.) clearance from the lower left hand frame rail.

VERIFICATION

⚠WARNING

Check vehicle alignment according to following procedures. Incorrect alignment can adversely affect stability and handling, which could result in death or serious injury. (00287a)

1. Verification of wheel alignment requires that the motorcycle meet specifications for the following components:
 a. Wheels. See 2.28 CHECKING CAST WHEEL RUNOUT.
 b. Tires. See 1.8 TIRES AND WHEELS.
 c. Steering head bearing "fall-away." See 1.19 STEERING HEAD BEARINGS.
 d. Belt deflection. See 1.10 DRIVE BELT AND SPROCKETS.
2. Place the motorcycle on a center stand to support the vehicle and lift the rear wheel off the ground.
 a. Place scissors jack under fuel tank mount with clearance for alignment bars.
 b. Do **NOT** support engine on oil sump. The engine must be free to shift slightly in its mounts.
 c. Be sure the motorcycle is as level as possible.
3. Identify the rear tire clearance to the rear fender and mounting hardware. The tire should appear to be centered and move through its travel without hitting other components.
4. Install a set of straightedges or alignment bars on both the left and right side of motorcycle alongside the front and rear tires.
 a. Both alignment bars should firmly contact the rear tire at two points on both sides of the tire.
 b. Use clamps or bungee cords to hold the bars in place. Tension should be equal to avoid spreading or pinching the bars.
 c. Verify that the bars are parallel by comparing the measurements between the bars at both ends.
5. See Figure 2-79. Straighten the front forks. From the front wheel rim, measure to the bar on one side of the motorcycle at the rear of the rim (A) and at the front of the rim (B) (two points). Straighten the front forks until the two measurements are equal (A = B).
6. See Figure 2-80. Measure vertical alignment by placing an inclinometer vertically on front and rear brake discs. Front and rear lean angles should be equal within +/- 1/2 degree.
7. See Figure 2-79. On the other side of the motorcycle, measure from the alignment bar to the front wheel rim (C)

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and compare measurement to that of the opposite side (B - C).

a. If opposing side measurements (B - C) are within +/- 6.35 mm (0.250 in.), the front and rear wheel are in alignment.

b. If the difference in opposing side measurements (B - C) is more than +/- 6.35 mm (0.250 in.), the front and rear wheel are out of alignment.

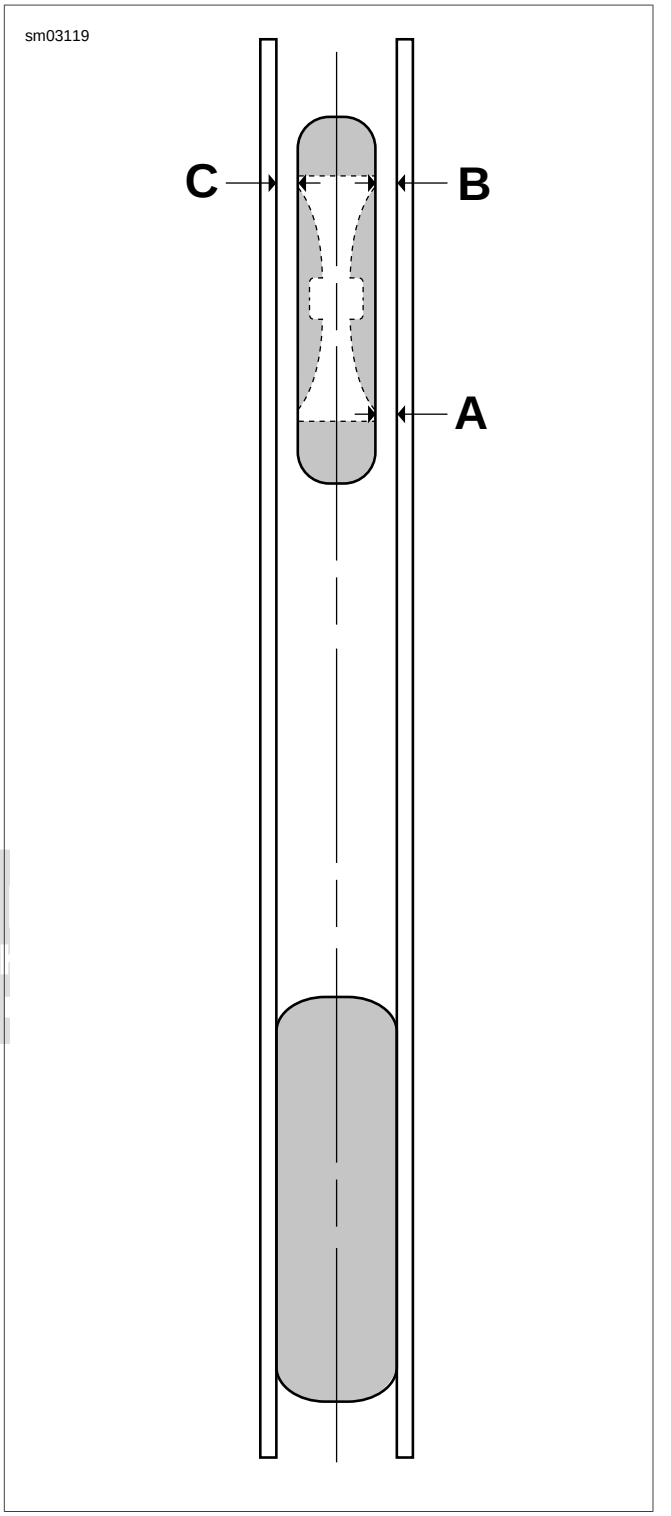


Figure 2-79. Wheel Alignment: When A = B and the Difference Between B and C is Less than +/- 6.35 mm (0.250 in.), the Front Wheel is Aligned to the Rear.

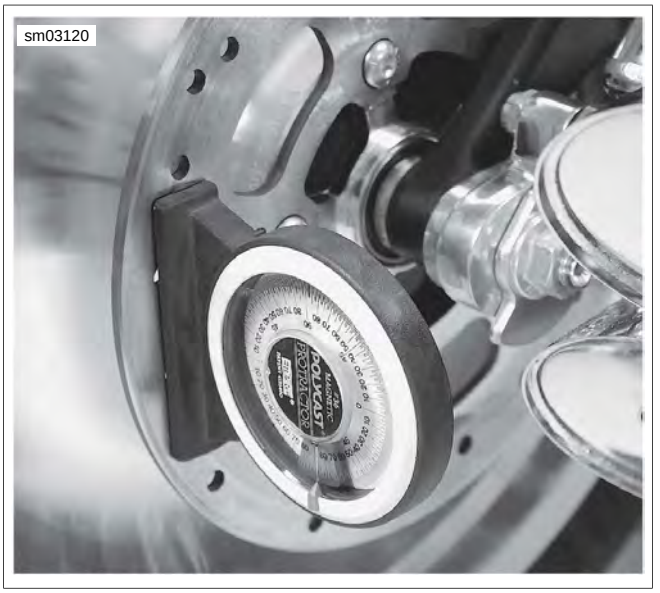


Figure 2-80. Measuring Vertical Alignment (typical)

CENTERING ENGINE

FASTENER	TORQUE VALUE	
Stabilizer link to frame tab fastener	34-41 Nm	25-30 ft-lbs
Stabilizer link ball end lock nuts (2)	34-41 Nm	25-30 ft-lbs

1. Verify wheel alignment. See 2.30 WHEEL ALIGNMENT.
2. See Figure 2-81. If the front and rear wheels are out of alignment, loosen and remove the engine stabilizer link from the tab on the frame. This allows the engine to center itself to the front and rear engine mounts.
3. Repeat alignment verification:
 a. See Figure 2-79. To straighten the front wheel, measure from the front wheel rim to the bar on one side at two points (A, B) along the wheel rim. Straighten the front wheel until the measurements are the same (A = B).
 b. Measure the front and rear brake disc vertical lean angles. The angles should be within +/- 1/2 degree.
 c. On the other side, measure the from the rim to the bar (C) and compare (B - C) to the measurement from the opposite side. The measurements must be within +/- 6.35 mm (0.250 in.).
 d. Check the left lower engine case to frame rail clearance. It should be at least 3.18 mm (0.125 in.).
 e. Identify clearance between the rear tire and the rear fender mounting hardware. The tire should appear to be centered and move through its suspension travel without hitting other components.

NOTE

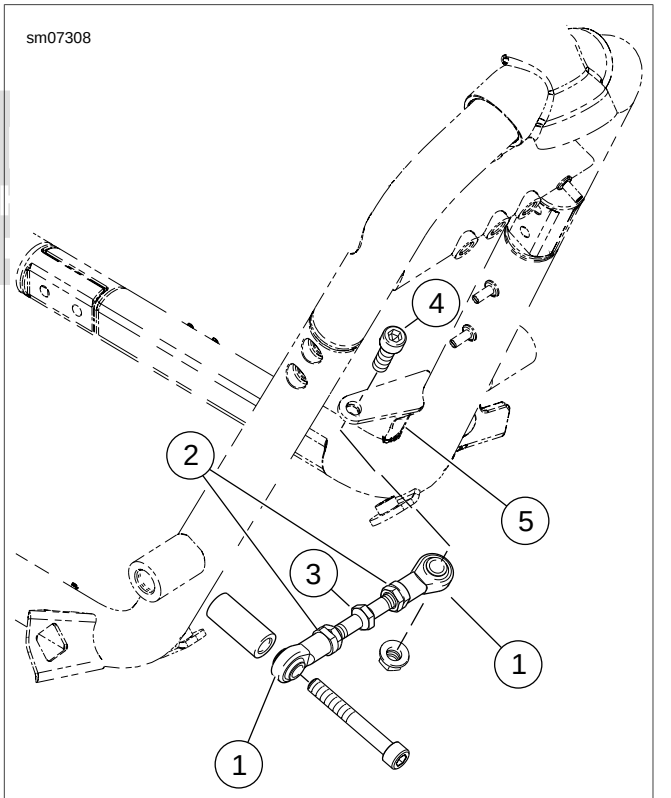
Lengthening or shortening the stabilizer link can put stress on the crankcase mounting boss. The stress may break or crack the crankcase mounting boss after light impact.

4. See Figure 2-81. The stabilizer link fastener (4) should fit freely through the ball end of the link (1) and the frame tab (5). If it does not, loosen lock nuts (2) on the ball ends (1) and use adjusting nut (3) and rod to adjust length of stabilizer link until stabilizer link bolt fits freely through ball end (1) of stabilizer link and frame tab (5).
5. Tighten stabilizer link to frame tab fastener (4) to 34-41 Nm (25-30 ft-lbs).

NOTE

If installing the stabilizer link causes interference between the rear tire and fender mounting hardware or the lower left crankcase and frame rail, the stabilizer link can be shortened or lengthened a short distance while fastened to frame tab and crankcase. Rotate the adjusting nut and rod (no more than two turns) to provide clearance. It is recommended to never turn the adjusting nut and rod more than two turns in or out with the stabilizer link fastened to the crankcase and the frame tab.

6. Tighten lock nuts on stabilizer link ball ends (1) to 34-41 Nm (25-30 ft-lbs).



1. **Ball ends**
2. **Lock nuts**
3. **Adjusting nut**
4. **Stabilizer link to frame tab fastener**
5. **Frame tab**

Figure 2-81. Engine Stabilizer Link

FRONT FENDER 2.31

ALL MODELS

FASTENER	TORQUE VALUE	
Fender to fork brace, front	4.1-6.8 Nm	36-60 **in-lbs**
Fork brace to forks, front	20-26 Nm	15-19 ft-lbs

See Figure 2-82. Install and tighten in a cross pattern to specification. Refer to Table 2-11.

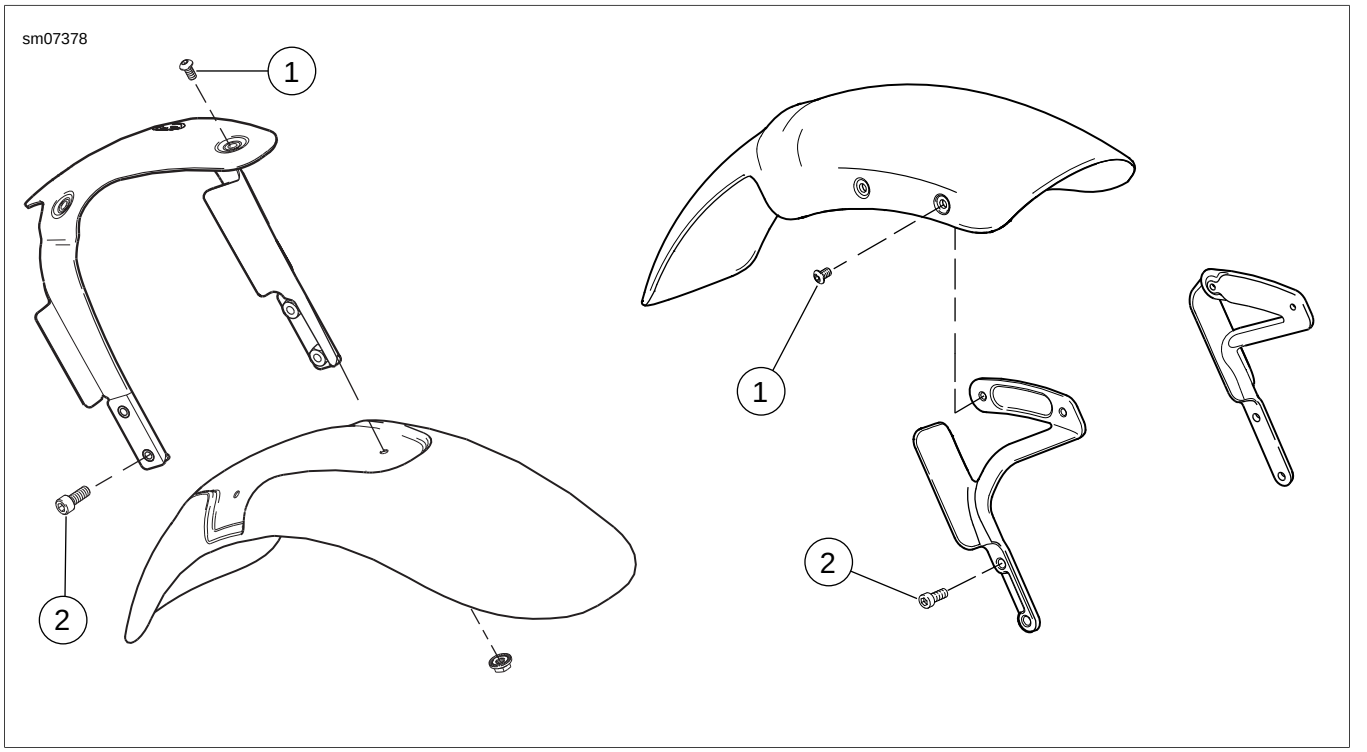


Figure 2-82. Front Fenders

Table 2-11. Front Fender Fastener Torque Values

MODEL	CALLOUT	FASTENER	TORQUE
All models	1	Fender to fork brace, front (tighten in cross pattern)	4.1-6.8 Nm (36-60 **in-lbs**)
	2	Fork brace to forks, front	20-26 Nm (15-19 ft-lbs)

FRONT FORK 2.32

REMOVAL

PART NUMBER	TOOL NAME
HD-48287	TRIPLE TREE WEDGE TOOL

1. Support motorcycle so front wheel is off floor and forks are fully extended.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove front fender. See 2.31 FRONT FENDER.
4. Remove front wheel. See 2.25 FRONT WHEEL.
5. Remove caliper mounting fasteners. See 2.18 FRONT BRAKE CALIPER.

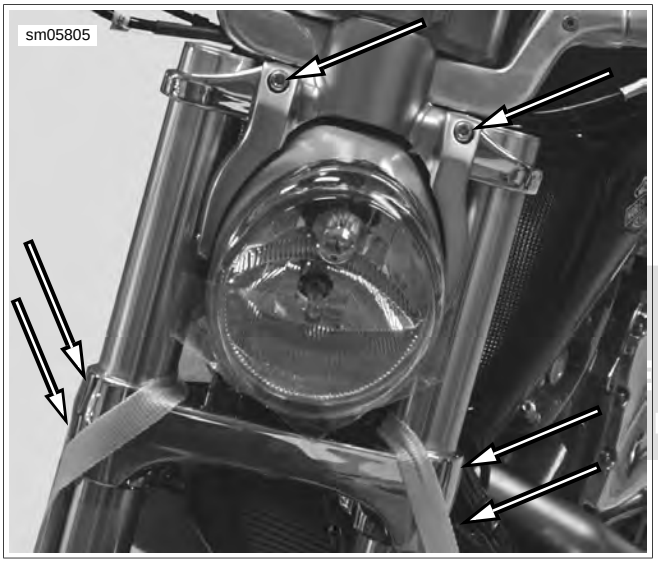


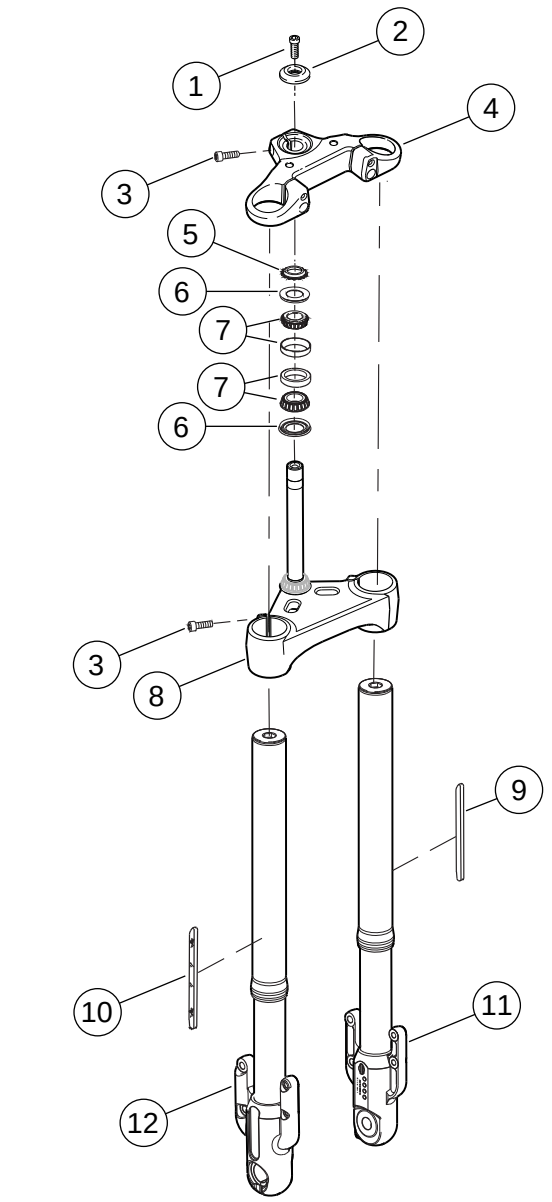
Figure 2-83. Pinch Bolt Locations (VRSCF)

NOTES

- *Any time fork pinch bolts are loosened or removed for any reason, follow this recommended procedure for proper installation.*
- *Replace loosened or removed fork pinch bolts with **new** fork pinch bolts. Tap triple clamp bolt holes with a bottoming tap and blow holes clear with compressed air to remove excess lockpatch material.*
- *When removing fork leg from triple trees, do not twist fork leg to avoid damage to cosmetic finishes.*
- *On VRSCDX models, remove headlamp mounting bracket as an assembly. See 7.13 HEADLAMP.*

6. See Figure 2-83. Remove and discard upper and lower fork clamp pinch bolts.
7. Using TRIPLE TREE WEDGE TOOL (Part No. HD-48287) insert wedge in triple clamps to relieve clamping pressure on fork tubes.
8. See Figure 2-84. Remove fork from upper and lower fork clamps.
9. Repeat steps 6 through 8 for other side.

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1. **Bolt**
2. **Steering washer**
3. **Pinch bolts**
4. **Top triple clamp**
5. **Adjusting nut - upper**
6. **Seal (2)**
7. **Roller bearing, w/cup**
8. **Bottom triple clamp**
9. **Reflector - right hand**
10. **Reflector, left hand**
11. **Fork assembly, left**
12. **Fork assembly, right**

Figure 2-84. Front Fork Assembly/Steering Head Components

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-41177	FORK TUBE HOLDER
HD-45966	FRONT FORK COMPRESSOR
HD-47852	INNER FORK NUT REMOVER/INSTALLER

Left Side

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTES

- *When using FRONT FORK COMPRESSOR (Part No. HD-45966) be sure not to bind the outer fork tube on the tool.*
- *FRONT FORK COMPRESSOR (Part No. HD-45966) comes with a cup and screw that are for FLT models only and not to be used with this fork assembly.*

1. See Figure 2-85. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.
2. Remove fork cap.

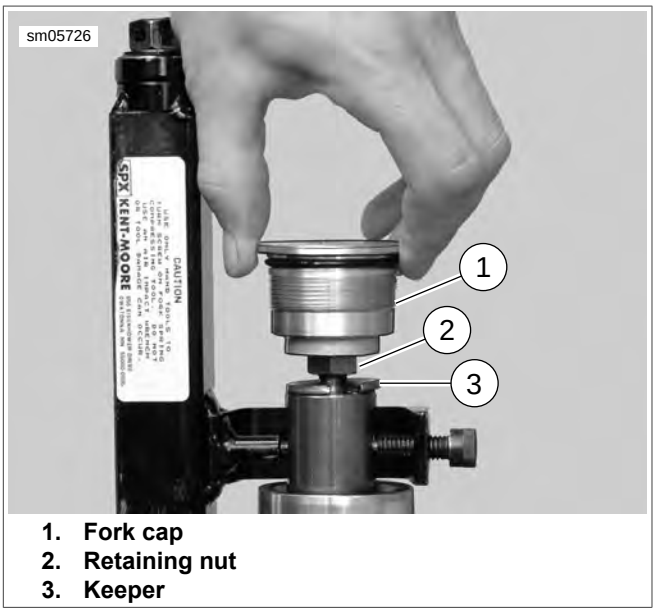


Figure 2-85. Clamp Fork and Remove Fork Cap



Figure 2-86. Compress Fork Assembly

3. See Figure 2-86. Compress fork using FRONT FORK COMPRESSOR (Part No. HD-45966).



1. **Fork cap**
2. **Retaining nut**
3. **Keeper**

Figure 2-87. Remove Keeper

4. See Figure 2-87. Remove keeper and loosen retaining nut, and fork cap from cartridge assembly.
5. Remove Front Fork Compressor.

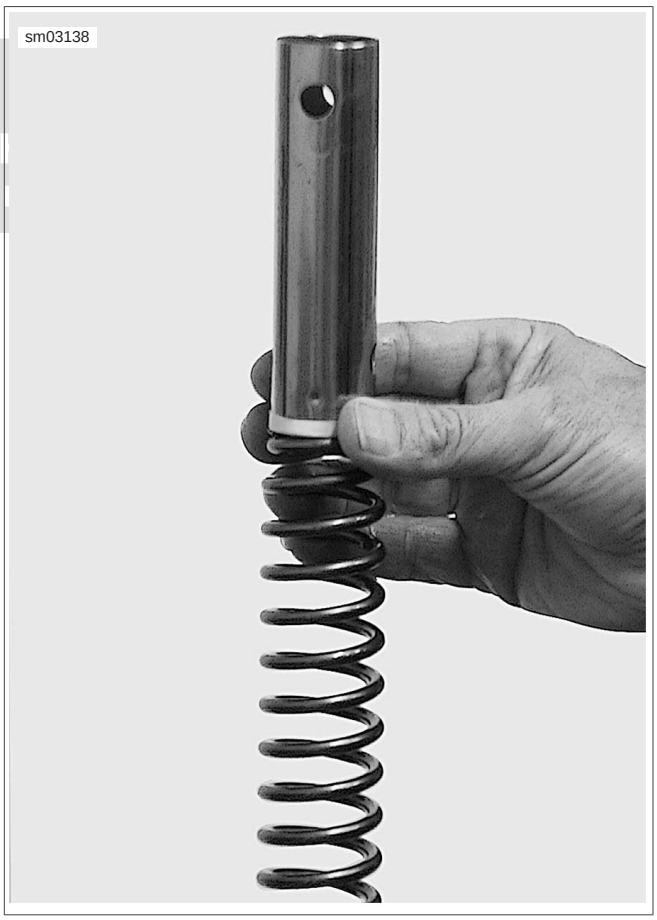


Figure 2-88. Remove Collar, and Spring Assembly

6. See Figure 2-88. Remove collar and spring from fork assembly.

7. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and stroke cartridge plunger to remove excess fork oil.

NOTE

If only performing a fork oil change, go to step 11 under ASSEMBLY.

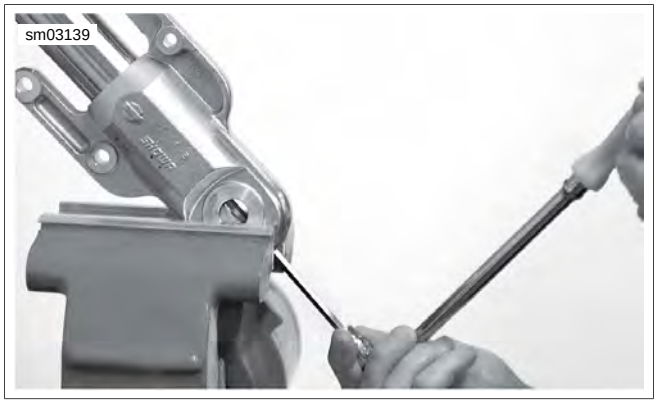


Figure 2-89. Remove Fastener and Copper Washer

NOTE

Always use soft jaws for bench vise when placing any fork components into vise to prevent damage to components.

8. See Figure 2-89. Place fork slider into bench vise with soft-jaws and remove fastener and copper washer from bottom of fork assembly.



Figure 2-90. Cartridge Assembly

9. See Figure 2-90. Reposition fork in vise using FORK TUBE HOLDER (Part No. HD-41177) to remove cartridge assembly from fork slider.

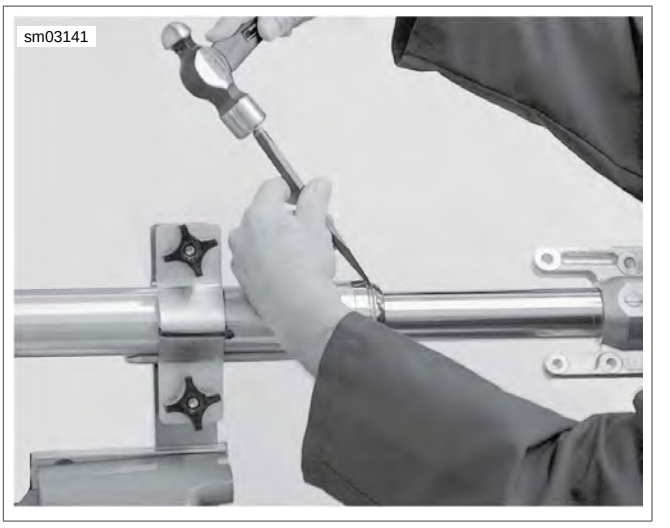
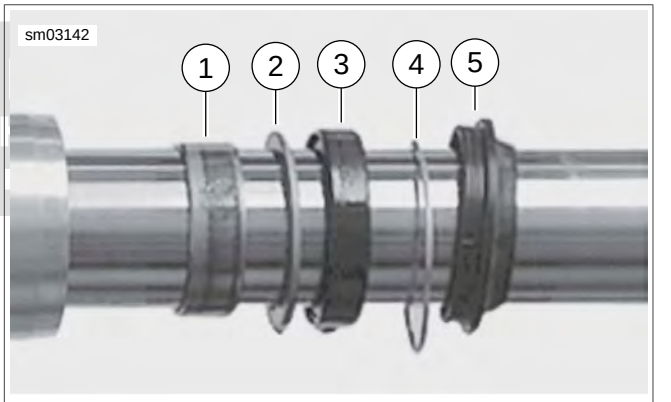


Figure 2-91. Remove Chrome Dust Cover

10. See Figure 2-91. Using a blunt soft object (such as a wood dowel or chisel with duct tape), gently tap chrome dust cover away from seat, remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, expand fork tube and slider against each other (in a slider-hammer effect) repeatedly to free fork slider from fork tube. Use caution not to damage components.



1. **Bushing**
2. **Spacer**
3. **Fork seal**
4. **Lock ring**
5. **Dust seal**

Figure 2-92. Seal Components

11. See Figure 2-92. Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

Right Side

⚠WARNING

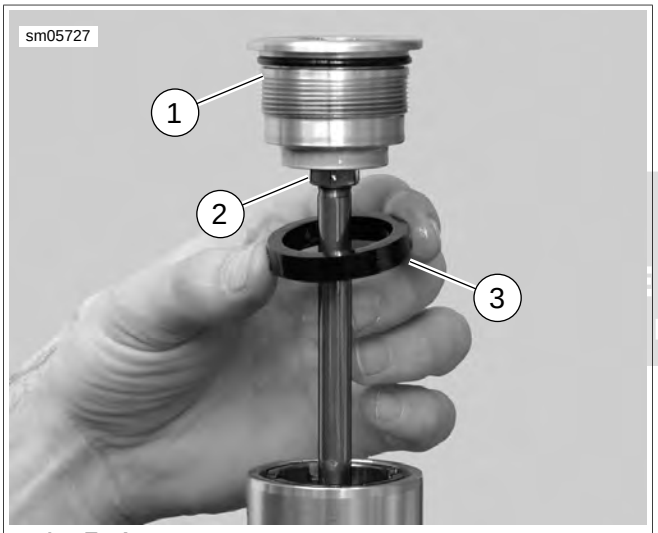
Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

1. See Figure 2-93. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.



Figure 2-93. Clamp Fork and Loosen Fork Cap

2. Loosen fork cap.



1. **Fork cap**
2. **Retaining nut**
3. **Rubber stopper**

Figure 2-94. Remove Fork Cap, Retaining Nut and Rubber Stopper

3. See Figure 2-94. Back retaining nut away from fork cap. Remove fork cap, retainer nut, and rubber stopper from inner fork nut threaded shaft.

NOTE

Do not fully extend fork assembly. Extending fork will cause oil to leak from bleed hole.

4. See Figure 2-95. Using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852) and remove inner fork nut assembly from fork tube.

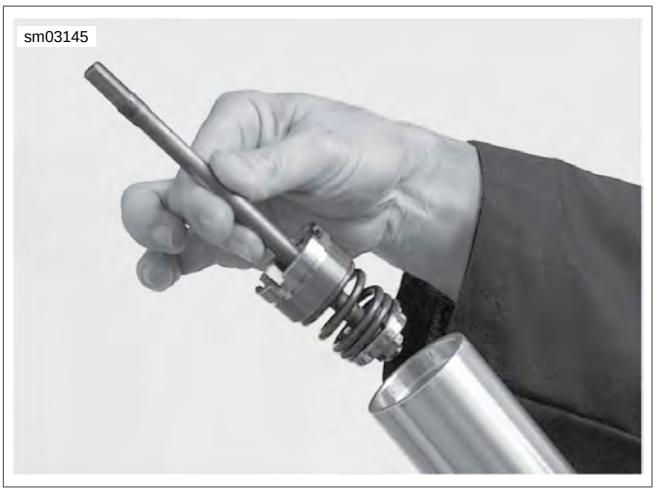


Figure 2-95. Inner Fork Nut

NOTE

Note positioning of collar, washer and spring for assembly.

5. See Figure 2-96. Remove collar, washer and spring from fork assembly.

6. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and drain excess fork oil into suitable container.

NOTE

If only performing a fork oil change, go to step 7 under ASSEMBLY.



Figure 2-96. Remove Collar, Washer and Spring

7. See Figure 2-97. Using FORK TUBE HOLDER (Part No. HD-41177), reposition fork assembly in vise.

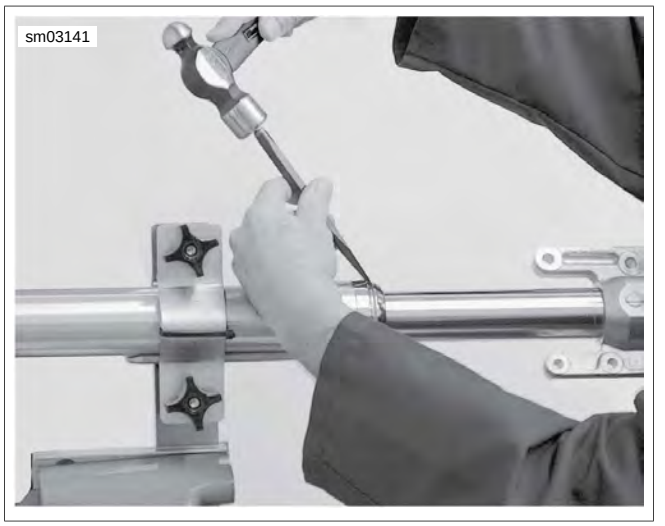
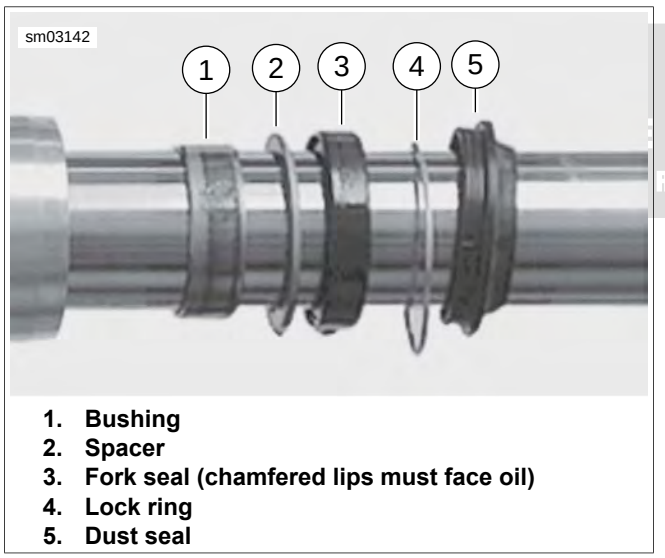


Figure 2-97. Remove Chrome Dust Cover

8. Use a blunt soft object (such as a wood dowel, or chisel with duct tape), to gently tap chrome dust cover away from seat. Remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, by expanding fork and slider against each other (in a slider-hammer effect) repeatedly, pull slider free from fork tube. Use caution not to damage components.



1. **Bushing**
2. **Spacer**
3. **Fork seal (chamfered lips must face oil)**
4. **Lock ring**
5. **Dust seal**

Figure 2-98. Seal Components

9. See Figure 2-98. Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

CLEANING AND INSPECTION

1. Thoroughly clean and inspect each part. Repair or replace any bent, inoperative or damaged parts.
2. Inspect fork tube bushing and slider guide bushing and replace as required.
3. Always replace oil seals and O-rings.
4. Check dust cover there it rubs on fork tube. Dust cover should not show any wear.
5. Replace inoperative springs.
6. Replace bent or damaged fork sliders.
7. Replace all other worn or damaged components as necessary.

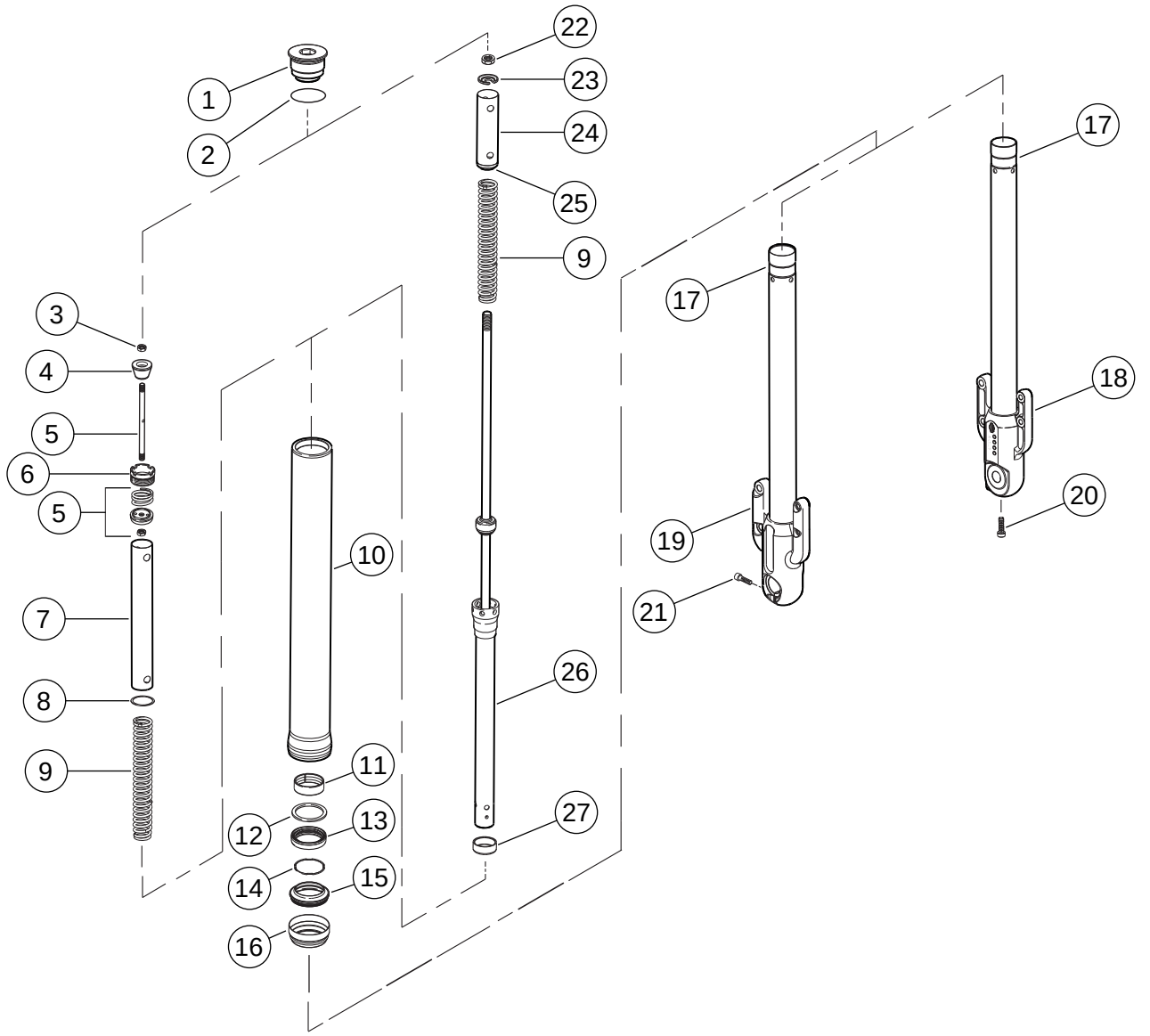
NOTES

- *Any time fork pinch bolts are loosened or removed for any reason, the following procedure must be performed. Fork tube installation process is extremely critical and must follow this procedure with no exceptions. Failure to properly clean the threads will cause improper torque readings upon assembly, causing loss of vehicle control, resulting in death or serious injury.*
- *Thoroughly clean all locking material from the fastener and bracket bolt hole threads. Fork pinch bolts must be thoroughly cleaned of all lock patch material. Fork bracket bolt holes must be tapped with a bottoming tap and blown clear with compressed air to remove excess lock patch material. If bolts can not be completely cleaned, it is required that **new** fork pinch bolts be installed.*

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

8. Clean bolt holes using a bottoming thread tap and blow bolt hole threads clean with compressed air.



1. Cap, slider tube (2)
2. O-ring (2)
3. Nut, right
4. Stopper, rubber
5. Joint rod, right only
6. Bolt, inner fork - right only
7. Spring collar, right only
8. Washer, right only
9. Spring (2)
10. Outer tube, left/right (2)
11. Guide bushing (2)
12. Seal spacer (2)
13. Oil seal (2)
14. Retaining ring, left only
15. Dust seal (2)
16. Cover, slider (2)
17. Slide bushing (2)
18. Slider, left
19. Slider, right
20. Screw, w/washer - left only
21. Bolt - right only
22. Nut, left
23. Spring seat - left only
24. Spring collar - left only
25. Spring joint - left only
26. Spring joint - left only
27. Centering plate - left only

Figure 2-99. Front Fork/VRSCF

ASSEMBLY

PART NUMBER	TOOL NAME
B-42571	FORK SEAL DRIVER
HD-41177	FRONT FORK TUBE HOLDER
HD-45966	FRONT FORK COMPRESSOR
HD-47852	INNER FORK NUT REMOVER/INSTALLER
HD-59000B	OIL LEVEL GAUGE

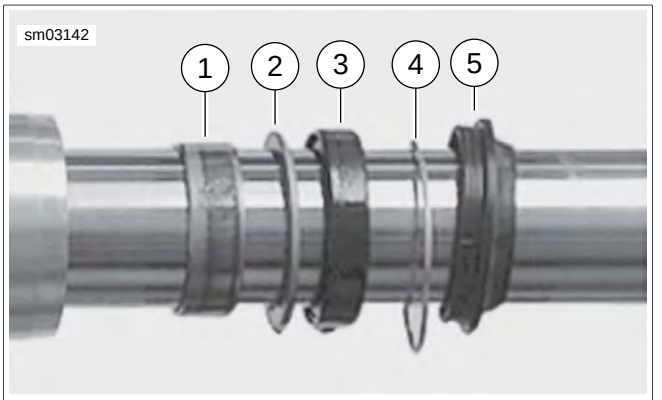
FASTENER	TORQUE VALUE	
Fork cartridge fastener	15-25 Nm	132-221 **in-lbs**
Retainer nut, left side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs
Fork cap	29-39 Nm	21.3-28.8 ft-lbs
Inner fork nut	93-113 Nm	69-83 ft-lbs
Retainer nut, right side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs
Fork cap	29-39 Nm	21.3-28.8 ft-lbs

Left Side

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

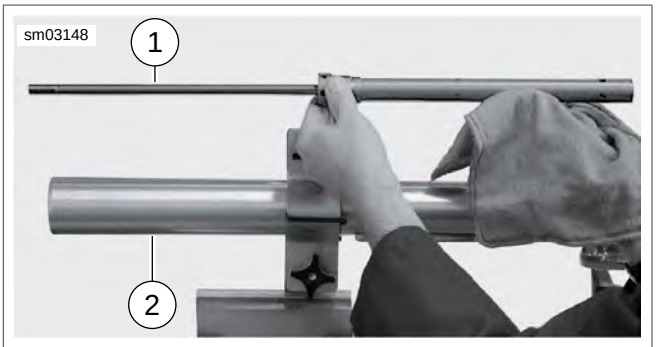
1. See Figure 2-100. Use sleeve from fork seal driver and install chrome dust cover (not shown) and components onto fork slider in order shown.



1. **Bushing**
2. **Spacer**
3. **Fork seal (chamfered lips must face oil)**
4. **Lock ring**
5. **Dust seal**

Figure 2-100. Fork Tube Shown Installed In Order of Installation

2. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.



1. **Fork cartridge**
2. **Fork tube**

Figure 2-101. Install Fork Cartridge

3. See Figure 2-101. Using FRONT FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.
4. Make sure cap (centering plate) is on bottom end of fork cartridge and install fork cartridge (big end first) into fork slider.
5. Remove fork and fork tube holder from vise.

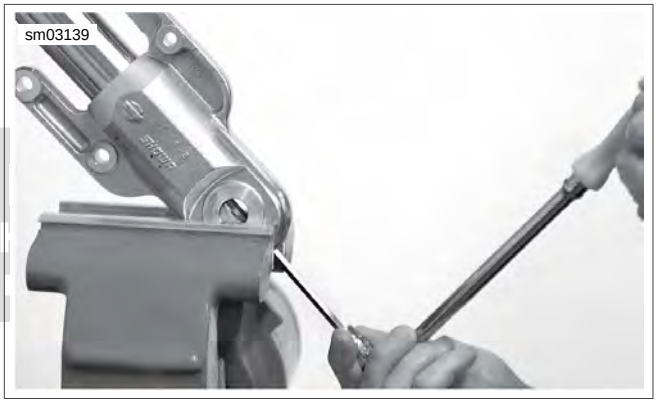


Figure 2-102. Install Fastener and Copper Washer

NOTE

Always use soft jaws for bench vise when placing any fork components into vise to prevent damage to components.

6. See Figure 2-102. Using a vise with soft jaws, clamp fork slider in vise. Install **new** fastener and copper washer to hold fork cartridge in install inside fork tube. Tighten to 15-25 Nm (132-221 **in-lbs**).
7. Reposition fork in vise using FRONT FORK TUBE HOLDER (Part No. HD-41177), secure fork assembly in vise.
8. See Figure 2-103. Assemble FORK SEAL DRIVER (Part No. B-42571) over fork slider in front of oil seal with the long end of tool facing seal. Install parts in the following order: bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
9. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated.



Figure 2-103. Install Bushing, Spacer, and Install Fork Seal in Place with Seal Driver

10. See Figure 2-104. Remove fork seal driver, reverse tool to short side of tool to prepare to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

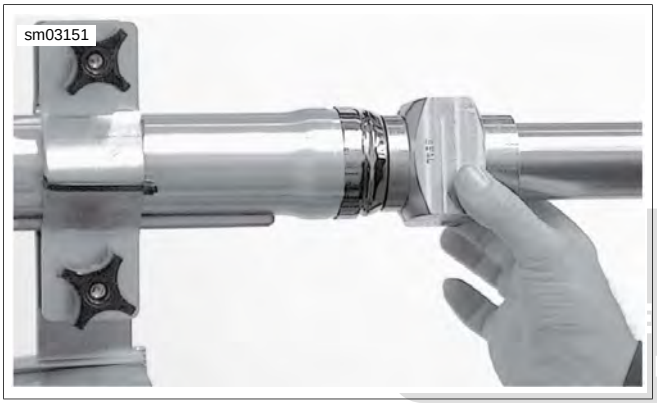


Figure 2-104. Install Chrome Dust Cover

Table 2-12. Oil Level, Left Fork

MEASUREMENT		VOLUME	
3.4 in.	87 mm	19.7 oz	584 cc

11. Reposition fork assembly to be vertical in vise and fully compressed.

12. Fill fork with TYPE "E" HYDRAULIC FORK OIL until it is approximately 50.8 mm (2.0 in.) from top of fork tube.

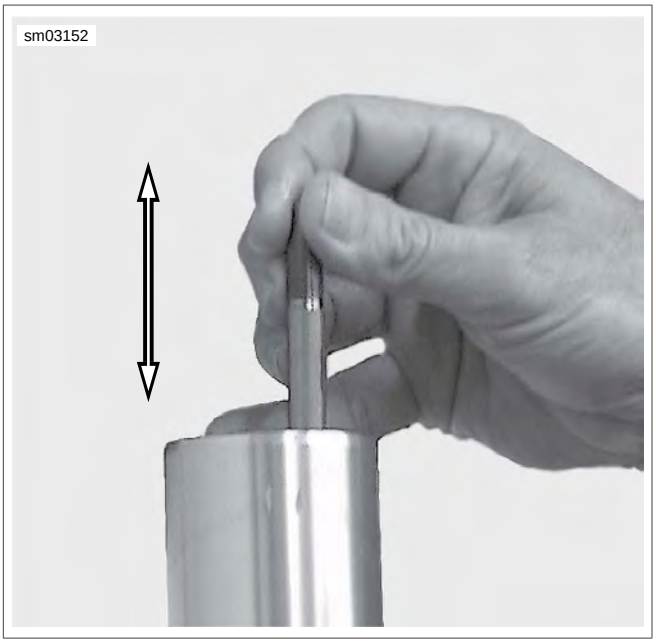


Figure 2-105. Pump Cartridge

13. See Figure 2-105. Slowly pump cartridge 8 to 10 times to exhaust air from assembly.



Figure 2-106. Measure Fork Oil

NOTE

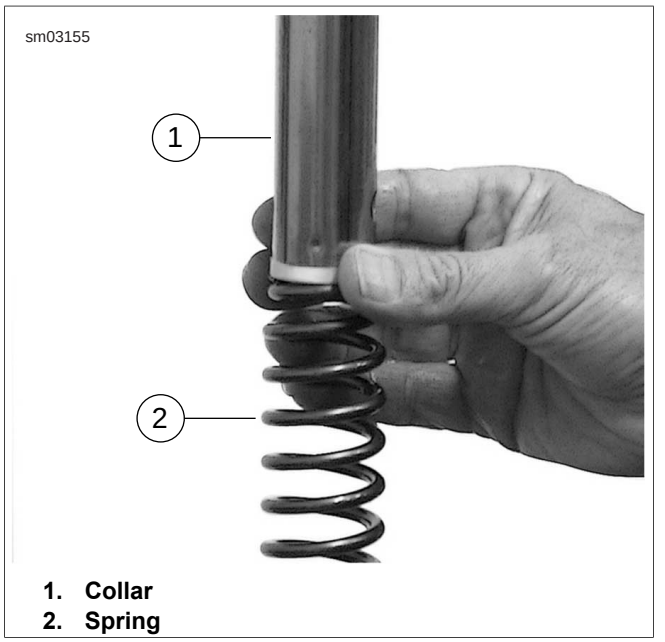
Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed. Measure fork oil level from top of fork tube using the OIL LEVEL GAUGE (Part No. HD-59000B).

14. See Figure 2-106. Fully compress fork and adjust the oil level to specification from top of fork tube using OIL LEVEL GAUGE (Part No. HD-59000B). Refer to Table 2-12.

NOTE

Coil windings tighten at top of spring. Be sure to install spring in this manner.

15. See Figure 2-107. Fully extend fork and install spring in fork tube (with tightly wound end at bottom), proceed to install washer and collar.



1. **Collar**
2. **Spring**

Figure 2-107. Collar and Spring Assembly

WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

16. Compress fork using FRONT FORK COMPRESSOR (Part No. HD-45966).

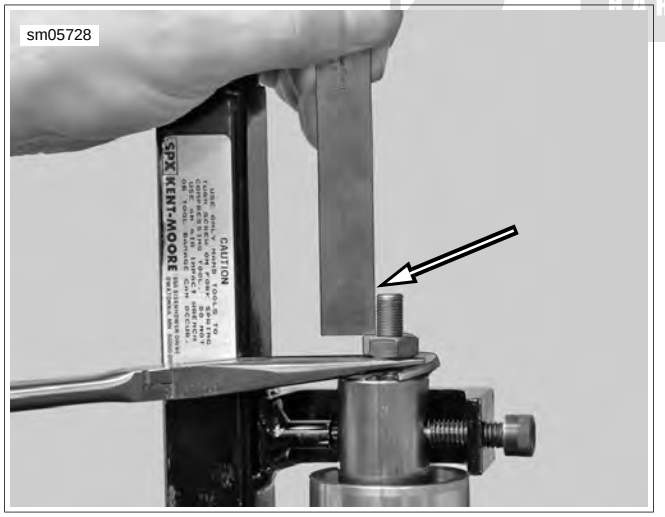


Figure 2-108. Measure Retaining Nut Installed Height

17. See Figure 2-108. Install retainer nut on cartridge rod 14 mm (0.551 in.) from top of rod and install fork cap onto cartridge rod.
18. Thread fork cap onto fork and tighten fork cap against retainer nut to 17.5-22.5 Nm (12.8-16.6 ft-lbs).
19. Release tension and remove fork compressing tool.

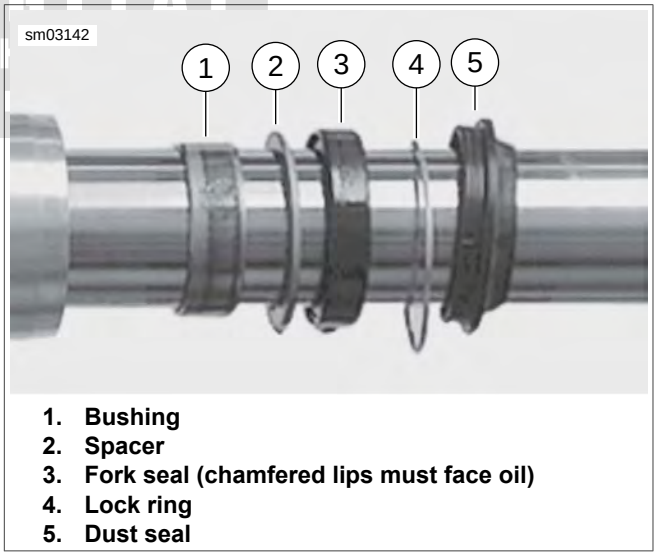


Figure 2-109. Install Fork Cap

20. See Figure 2-109. Thread fork cap into fork and tighten to 29-39 Nm (21.3-28.8 ft-lbs).

Right Side

1. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and fully compress fork.
2. See Figure 2-110. Install chrome dust cover (not shown) and components onto fork slider in order shown.



1. **Bushing**
2. **Spacer**
3. **Fork seal (chamfered lips must face oil)**
4. **Lock ring**
5. **Dust seal**

Figure 2-110. Seal Components

3. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.



Figure 2-111. Install Seal Components

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

4. See Figure 2-111. Assemble the FORK SEAL DRIVER (Part No. B-42571) over fork slider in front of oil seal with the long end of tool facing seal and assemble in the following order: Install bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
5. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated.
6. See Figure 2-112. Remove FORK SEAL DRIVER and reverse tool to short side of tool to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

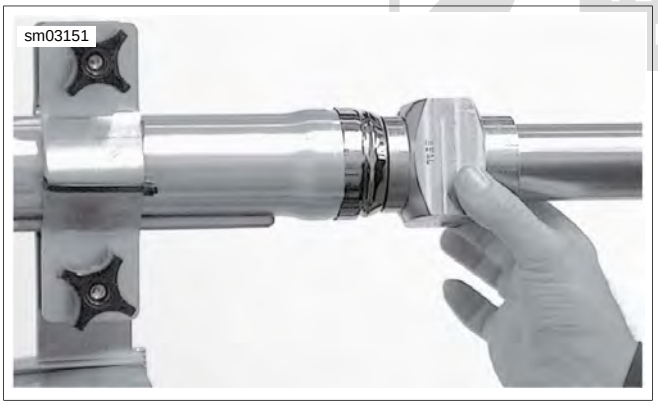


Figure 2-112. Install Chrome Dust Cover

Table 2-13. Oil Level, Right Fork

MEASUREMENT		VOLUME	
3.7 in	99 mm	23.1 oz	654 cm^3

7. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and fully compress fork.

NOTE

Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed. Measure fork oil level from top of fork tube using the OIL LEVEL GAUGE (Part No. HD-59000B).

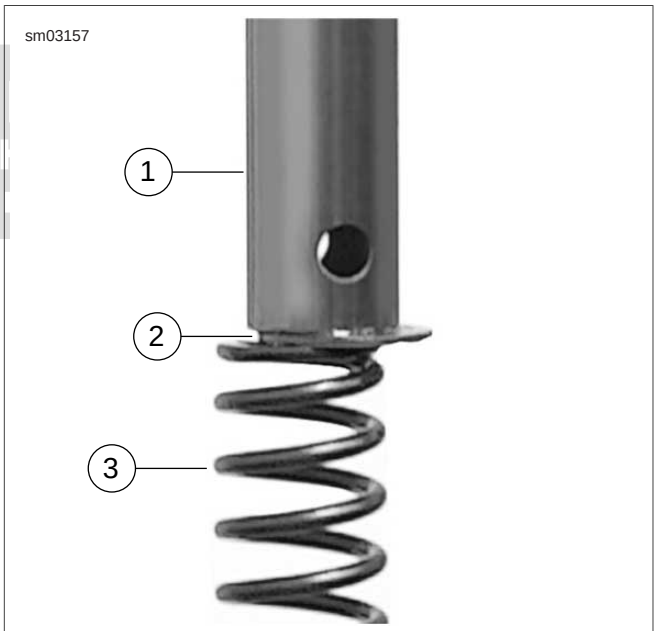
8. Fill fork with TYPE E HYDRAULIC FORK OIL to specification shown in Table 2-13.

 Fill fork with TYPE E HYDRAULIC FORK OIL until it is approximately 50.8 mm (2.0 in.) from top of fork tube.
9. See Figure 2-106. Fully compress fork and adjust the oil level to specification from top of fork tube using OIL LEVEL GAUGE (Part No. HD-59000B). Refer to Table 2-12.



Figure 2-113. Measure Fork Oil

10. Fully extend fork.



1. **Spring collar**
2. **Washer**
3. **Rebound spring**

Figure 2-114. Collar, Washer and Spring Assembly

11. See Figure 2-114. Install rebound spring in fork tube (with tightly wound end at top), washer, and spring collar.
12. Verify that washer has properly seated on top of spring.



Figure 2-115. Inner Fork Nut

13. See Figure 2-115. Insert inner fork nut and finger tighten.

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTE

To prevent cross threading fork tube damper cups and caps, use caution when threading in the caps with the spring compressed. It may be helpful to use a palm-ratchet during this process.

14. See Figure 2-116. Final tighten inner fork nut to 93-113 Nm (69-83 ft-lbs) using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852).

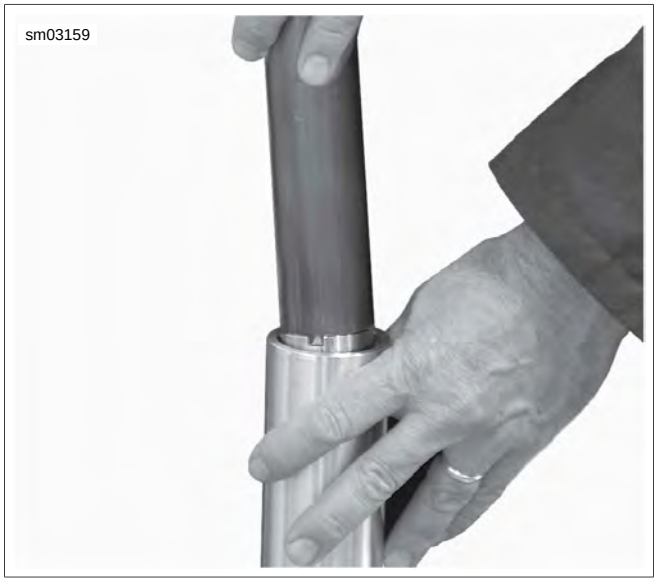
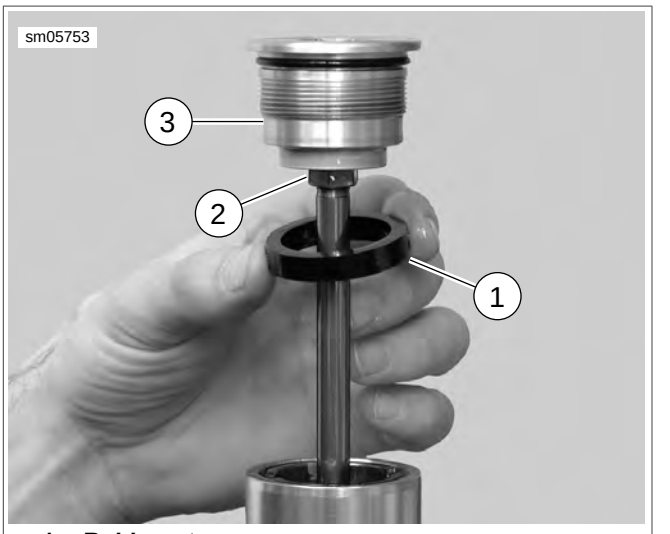


Figure 2-116. Hand Tighten

15. See Figure 2-117. Install rubber stopper, followed by retainer nut (retainer nut must be installed 14 mm (0.551 in) from top of threaded shaft).



1. **Rubber stopper**
2. **Retainer nut**
3. **Fork cap**

Figure 2-117. Install Rubber Stopper, Retaining Nut, and Fork Cap

16. Thread fork cap onto fork and tighten fork cap against retainer nut to 17.5-22.5 Nm (12.8-16.6 ft-lbs).

17. See Figure 2-109. Apply a light coat of fork oil on O-ring and thread cap into fork tube. Thread fork cap into fork and tighten to 29-39 Nm (21.3-28.8 ft-lbs).

INSTALLATION

PART NUMBER	TOOL NAME
HD-48287	TRIPLE TREE WEDGE TOOL

FASTENER	TORQUE VALUE	
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs
Steering stem pinch bolt (initial torque)	34 Nm	25.0 ft-lbs
Steering stem pinch bolt (second step)	8-11 Nm	70.8-97.3 **in-lbs**
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

NOTES

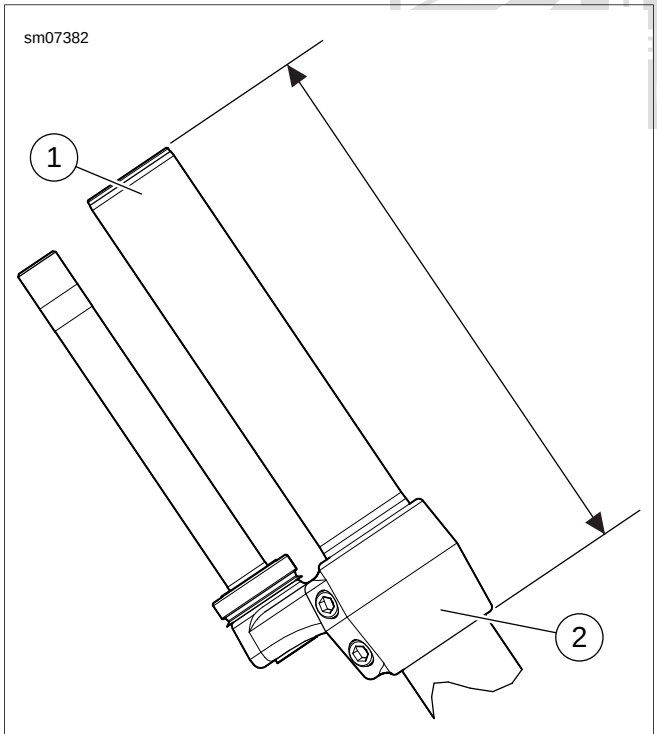
- *Any time fork pinch bolts are loosened or removed for any reason, follow this recommended procedure for proper installation.*
- *Replace loosened or removed fork pinch bolts with **new** fork pinch bolts. Tap triple clamp bolt holes with a bottoming tap and blow holes clear with compressed air to remove excess lockpatch material.*
- *Fork tube depth measurement is critical and must match the opposite side exactly to maintain proper vehicle operation, reliability and performance.*
- *When installing fork leg from triple trees, do not twist fork leg to avoid damage to cosmetic finishes.*

1. Identify left and right side fork assemblies.
2. Insert fork assembly from the bottom triple clamp upward through the top triple clamp.
3. Remove TRIPLE TREE WEDGE TOOL (Part No. HD-48287) installed in triple clamp clamps during removal process.

NOTE

Fork tube protrusion should be measured from the bottom of the lower triple clamp to the top of the fork tube.

4. See Figure 2-118. Measure protrusion from bottom of the lower triple clamp (2) to top of fork tube (1). Both sides must have exactly the same protrusion and measure 312.9-318.9 mm (12.32-12.56 in).



1. **Fork tube**
2. **Lower triple clamp**

Figure 2-118. Fork Tube Protrusion

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

5. Install **new** pinch bolts containing lock patch.
6. Using a torque wrench, tighten pinch bolts in the following sequence.
 a. Tighten bolt in upper triple clamp to 41-47 Nm (30-35 ft-lbs).
 b. Tighten top bolt in lower triple clamp to 41-47 Nm (30-35 ft-lbs).
 c. Tighten bottom bolt in lower triple clamp to 41-47 Nm (30-35 ft-lbs).
 d. Final tighten top bolt in upper triple clamp to 41-47 Nm (30-35 ft-lbs).
 e. Final tighten top bolt in lower triple clamp to 41-47 Nm (30-35 ft-lbs).
 f. Final tighten lower bolt in lower triple clamp to 41-47 Nm (30-35 ft-lbs).
7. Repeat for other side of fork.
8. Install steering stem pinch bolt. Tighten bolt to 34 Nm (25.0 ft-lbs). Back bolt off 100 degrees and torque to 8-11 Nm (70.8-97.3 **in-lbs**). Then final tighten to achieve 51-102 mm (2-4 in) of fall away.
9. On VRSCDX models, install headlamp assembly. See 7.13 HEADLAMP.
10. Install front fender and bracket. See 2.31 FRONT FENDER.
11. Install front brake caliper hydraulic lines and install front brake calipers. See 2.18 FRONT BRAKE CALIPER.
12. Install front wheel and align the wheel to the forks. See 2.25 FRONT WHEEL.
13. Install negative battery cable. Tighten to 6.8-7.9 Nm (60-70 **in-lbs**).
14. Install main fuse and right side cover.

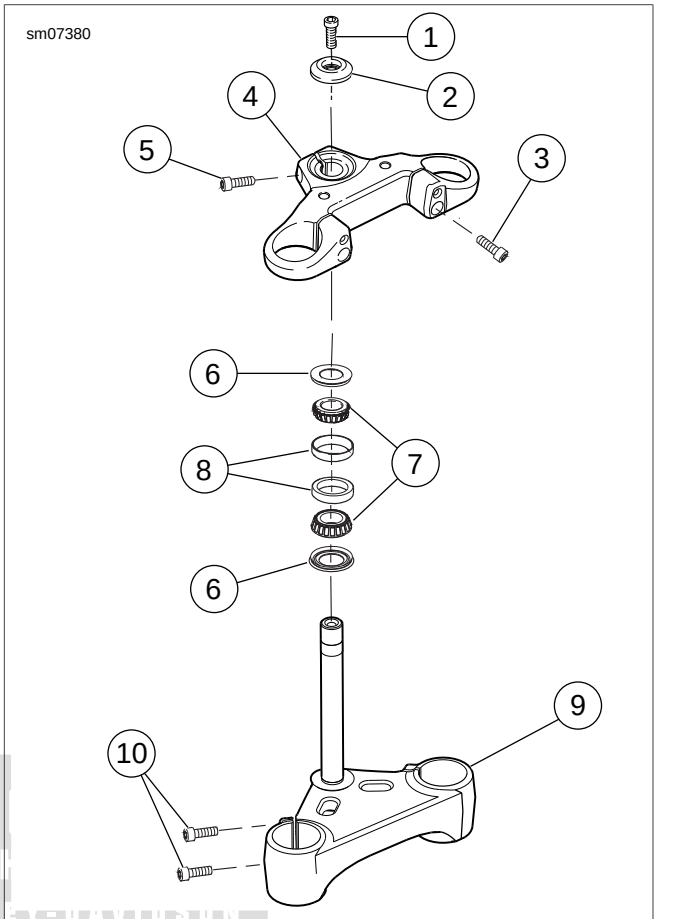
STEERING HEAD 2.33

REMOVAL

NOTE

If bearing races are removed, the bearings cannot be reused, they must be replaced. See 2.33 STEERING HEAD, Cleaning and Inspection.

1. Support motorcycle so front wheel is off floor and forks are fully extended.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove headlamp and headlamp bracket. See 7.13 HEADLAMP.
4. Remove both front brake calipers. See 2.18 FRONT BRAKE CALIPER.
5. Remove front wheel. See 2.25 FRONT WHEEL.
6. Remove front fender bracket with front fender. See 2.31 FRONT FENDER.
7. See Figure 2-119. Loosen all pinch bolts on top and bottom triple clamps and pull fork tubes from triple clamps.
8. Remove brake hose bracket from the bottom of stem and lower fork bracket (9).
9. Remove bolt (1) and steering washer (2). Pull stem and lower bracket from bottom of steering head while lifting handlebars from steering head with upper fork bracket (4) attached. Be careful not to pinch or kink control cables.
10. Remove seal (6).
11. Remove roller bearing (7) from bearing cup (8).



1. **Bolt**
2. **Steering washer**
3. **Upper bracket screw (4)**
4. **Upper bracket**
5. **Steering stem pinch bolt**
6. **Seal (2)**
7. **Roller bearing (2)**
8. **Bearing cup (2)**
9. **Stem and lower bracket**
10. **Lower bracket screw (4)**

Figure 2-119. Steering Head

CLEANING AND INSPECTION

PART NUMBER	TOOL NAME
HD-33416	UNIVERSAL DRIVER HANDLE
HD-39301-A	STEERING HEAD BEARING RACE REMOVER
HD-95637-46A	UNIVERSAL WEDGE ATTACHMENT

1. Check upper and lower bearing races in steering head. If they are pitted or grooved, replace bearings and races in sets.
2. Check roughness of bearings by turning them in race. Replace bearings if they do not turn freely and smoothly.

NOTICE

Replace both bearing assemblies even if one assembly appeares to be good. Mismatched bearings can lead to excessive wear and premature replacement. (00532b)

Lower Fork Stem Bearing

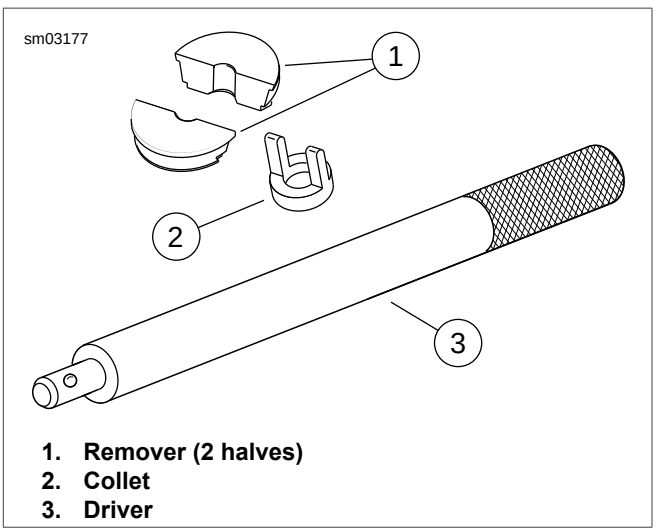
1. See Figure 2-120. Assemble a bearing puller using a using a UNIVERSAL WEDGE ATTACHMENT (Part No. HD-95637-46A), two lengths of threaded rod, washers, nuts, a cross clamp or bridge, and a forcing screw and a washer or protective cap.
2. Turn forcing screw to remove bearings and seal from lower triple clamp.

Steering Head Bearing Race

1. See Figure 2-121. With the tapered side down, seat STEERING HEAD BEARING RACE REMOVER (Part No. HD-39301-A) on upper bearing race leaving a gap in middle and with lower lip of removers capturing bottom edge of bearing race.
2. Install collet on driver.
3. Insert UNIVERSAL DRIVER HANDLE (Part No. HD-33416) at bottom of steering head tube, and while holding remover tool on race, center collet in gap between remover halves. Tap driver to remove upper race.
4. Reverse tool and repeat procedure to remove lower bearing race.



Figure 2-120. Bearing Puller Based on Universal Wedge Attachment (typical)



1. **Remover (2 halves)**
2. **Collet**
3. **Driver**

Figure 2-121. Race Remover Tools (HD-33416 and HD-39301-A)

ASSEMBLY

PART NUMBER	TOOL NAME
HD-39302	STEERING HEAD BEARING RACE INSTALLER

1. Lubricate outside of **new** steering head bearing races with lubricant provided or engine oil.
2. See Figure 2-122. Assemble STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302) and bearing races on tool's draw down bolt through steering head. Position races so lettered edges are at bottom of steering head bore in steering head.
3. Continue to thread nut on draw down bolt until races fit, and are parallel to steering head bore.
4. Slowly tighten nut while stopping periodically to check for bearing race to steering head parallelism.

⚠WARNING

Properly seat bearing cups in steering head bore. Improper seating can loosen fork stem bearings adversely affecting stability and handling, which could result in death or serious injury. (00302a)

5. When bearing races are fully seated in bore of steering head, pack **new** bearings with SPECIAL PURPOSE GREASE.

NOTE

Do not use a sleeve that is larger than the inner race of the bearing or bearing cage may be damaged. A damaged bearing cage will require replacement of both the cage and the bearing.

6. Install a **new** lower seal on fork stem.
7. Use sleeve or drift that will contact only inner race of bearing and press lower bearing into place on fork stem.

NOTE

A sleeve (drift) to press on the lower fork stem bearing can be constructed out of thick-walled pipe, 22.86 cm (9.0 in) long with an inside diameter of 25.65 mm (1.010 in) and an outside diameter of 31.75 mm (1.250 in).

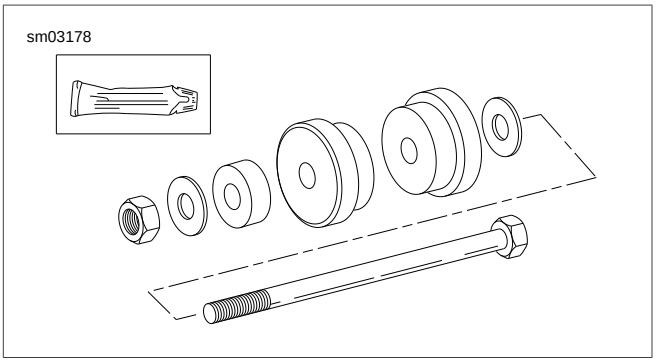


Figure 2-122. Steering Head Bearing Race Installer (HD-39302)

INSTALLATION

PART NUMBER	TOOL NAME
HD-48287	TRIPLE TREE WEDGE TOOL

FASTENER	TORQUE VALUE	
Front brake hose bracket bolt	6-10 Nm	53-89 **in-lbs**

1. See Figure 2-119. Install fork stem and lower bracket (9) with **new** seal (6) and **new** greased roller bearing (7) into frame steering head.
2. Install **new** greased roller bearing and **new** seal (6) into upper frame neck bearing race.
3. Install upper bracket (4), steering washer (2) and bolt (1). Do not tighten at this time.

NOTE

The TRIPLE TREE WEDGE TOOL (Part No. HD-48287) may be necessary for assembly and fall away adjustments.

4. Install forks and verify fork protrusion measurement. See 2.32 FRONT FORK.
5. Install front fender and bracket. See 2.31 FRONT FENDER.
6. Install front wheel assembly. See 2.25 FRONT WHEEL.
7. Install right and left front brake calipers. See 2.18 FRONT BRAKE CALIPER.

⚠WARNING

Properly adjust fork stem bearings. Improper adjustments affect stability and handling, which could result in death or serious injury. (00301a)

8. Adjust steering head bearing fall away. See 1.19 STEERING HEAD BEARINGS.
9. Fasten brake hose bracket to lower bracket (9). Tighten bolt to 6-10 Nm (53-89 **in-lbs**).
10. Install main fuse and right side cover. See 7.6 MAIN FUSE.

FORK LOCK 2.34

GENERAL

To ensure that the ignition key and the fork lock key are the same, both locks may need to be changed when one is changed.

REMOVAL

1. See 2.33 STEERING HEAD, Removal. Remove the upper triple clamp.
2. See Figure 2-123. Insert ignition key (1) and turn half-way so that plunger (4) rotates in plunger boss (9).
3. Look into the half-moon opening (8) on back of fork lock boss. The slot (5) in plunger (4) should be visible in the opening.

NOTE

If the plunger shot is not visible in the half-moon opening with the key half-way between lock and unlock, the plunger can be rotated with pliers counterclockwise to compress the rotation pin and remove the plunger.

4. Using a thin tool, press in rotation pin (3) through slot (5) in plunger.
5. While pressing rotation pin (3) in, push up through small hole in bottom of plunger boss (9) until plunger (4) holds rotation pin (3) in. Remove tool and continue to push plunger (4) out of plunger boss (9).
6. Use ignition key (1) to pull tumbler (7) out.

INSTALLATION

1. Lightly grease open end of tumbler.

NOTE

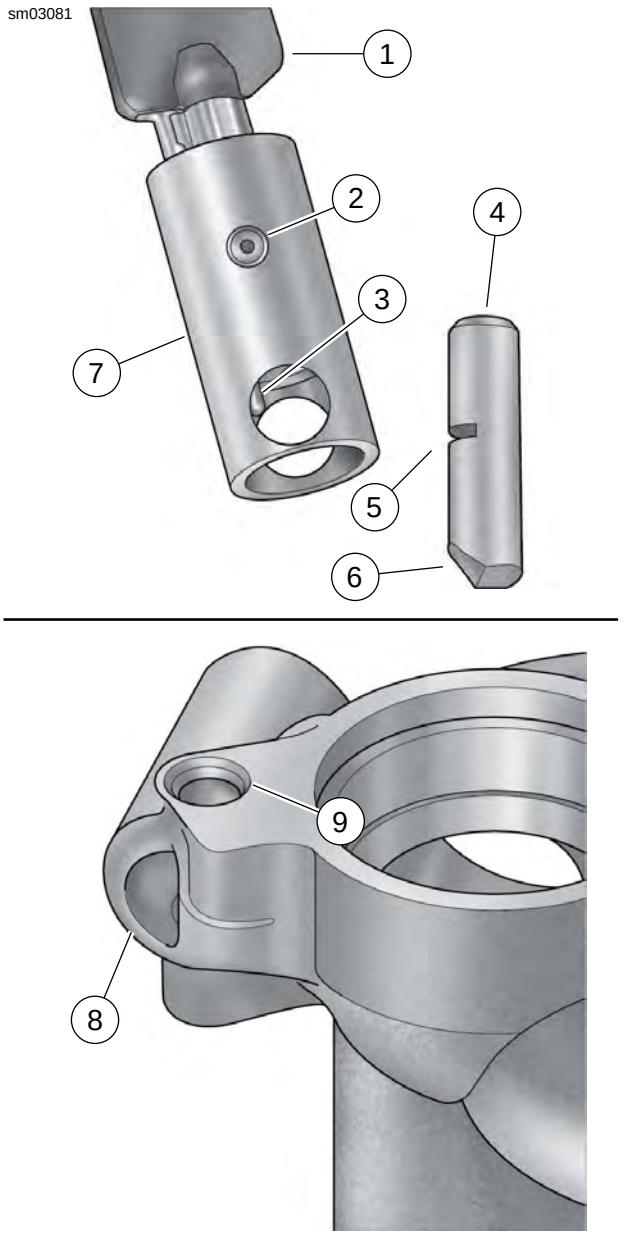
The lock can be installed so that the key will lock the forks with either a counterclockwise or clockwise turn. When the splined retaining key is on top of tumbler, the key will rotate counter-clockwise to lock the forks and clockwise to unlock the forks.

2. See Figure 2-123. Slide tumbler (7) into fork lock boss (8) with rotation pin (3) and retaining key (2) at the top of the fork lock boss (8).

NOTE

The beveled end of the plunger will compress the rotation pin so that the plunger can be slid into place.

3. With the beveled end of plunger (6) facing the rotation pin (3), push the plunger into boss until plunger locks into place.
4. Turn the key from notch to notch. Locking pin should be below fork lock boss in unlocked position and 6.35 mm (0.250 in) above boss in locked position.
5. Install upper triple clamp. See 2.33 STEERING HEAD, Installation.



1. **Key - 1/2 way rotation**
2. **Retaining key**
3. **Rotation pin - 1/2 way rotation**
4. **Plunger**
5. **Plunger slot**
6. **Plunger bevel**
7. **Tumbler**
8. **Half-moon opening - fork lock boss**
9. **Plunger boss**

Figure 2-123. Fork Lock Components

BELT GUARD AND DEBRIS DEFLECTOR 2.35

REMOVAL

Belt Guard

1. See Figure 2-124. Unthread left side lower shock mount bolt from belt guard (1) without removing shock mount bolt from rear fork.
2. Pull belt guard (1) rearward off of side rubber grommet (5) and upper rubber grommet (6). If necessary, remove fasteners (3) holding grommets (5, 6) to rear fork.
3. Inspect rubber grommets (5, 6) on the rear fork and remove the bolts and rubber grommets if necessary.

Debris Deflector

1. See Figure 2-124. Remove fastener (3) and washer (4) from the underside of the rear fork near the rear shock mount.
2. Pull the debris deflector (8) rearward off of the lower rubber grommet (7) and remove the debris guard.
3. Inspect the rubber grommet (7) on the rear fork and remove the bolt and rubber grommet if necessary.

INSTALLATION

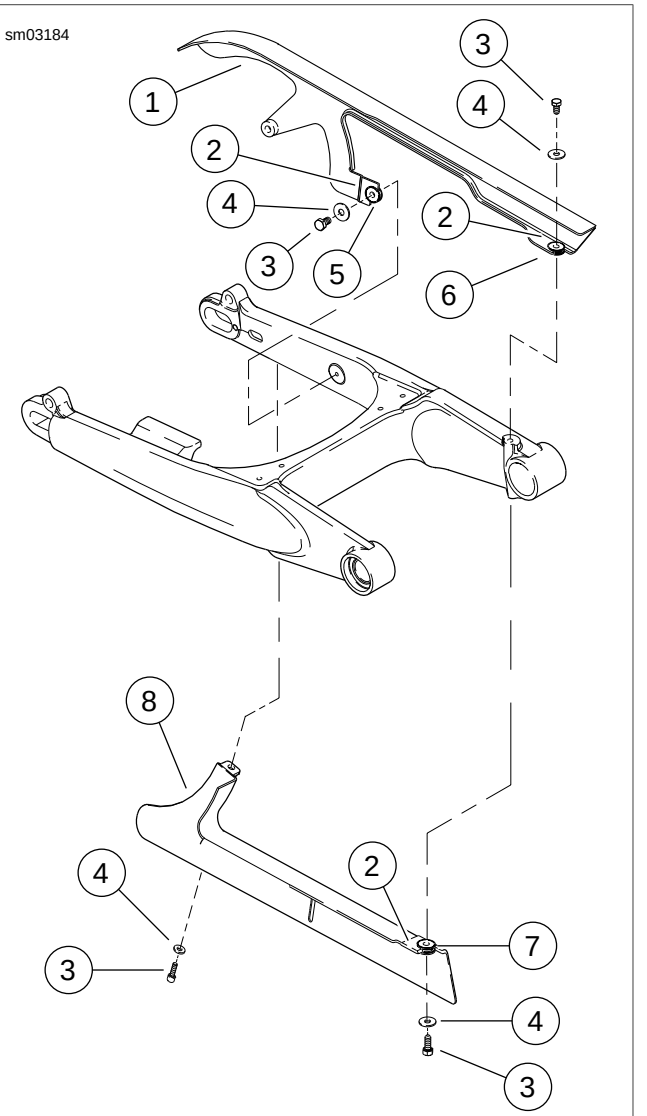
FASTENER	TORQUE VALUE	
Belt guard fasteners	6-10 Nm	53-88 **in-lbs**
Belt guard grommet bolt	6-10 Nm	53-88 **in-lbs**
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**

Belt Guard

1. See Figure 2-124. Replace the rubber grommets (5, 6) and bolts as necessary. Tighten 6-10 Nm (53-88 **in-lbs**)
2. Slide the belt guard slots into position on the rubber grommets.
3. Install lower rear shock mount into thread boss on belt guard. See 2.36 REAR SHOCK ABSORBERS.
4. Measure guard to drive sprocket clearance, if clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.

Debris Deflector

1. See Figure 2-124. If necessary, replace rubber grommet (7) and fastener (3). Tighten fastener to 6-10 Nm (53-88 **in-lbs**).
2. Slide debris deflector slot (2) into position on the rubber grommet (7).
3. Thread rear fastener (3) and washer (4) through debris deflector (8) into rear fork. Tighten fastener to 6-10 Nm (53-88 **in-lbs**).



1. **Belt guard**
2. **Slot**
3. **Fastener**
4. **Washer**
5. **Side rubber grommet**
6. **Upper rubber grommet**
7. **Lower rubber grommet**
8. **Debris deflector**

Figure 2-124. Belt Guard/Debris Deflector (typical)

REAR SHOCK ABSORBERS 2.36

REMOVAL

1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
2. See Figure 2-125. Remove right side lower fastener (1), washer (5), and thin height hex-nut (6) attaching right side shock to rear fork.
3. Remove left lower fastener (1) and washer (5) from left side shock to rear fork and belt guard. Allow rear tire to rest on ground.
4. Remove left side upper fastener (3) from left side top shock mount and remove shock.
5. Remove right side fastener (2) from right side top shock mount and remove shock.

NOTE

The rear shock absorbers on VRSC motorcycles are not repairable. If a shock absorber becomes worn or damaged, it must be replaced as an assembly.

INSTALLATION

FASTENER	TORQUE VALUE	
Shock mount fasteners	41-68 Nm	31-50 ft-lbs

1. Insert right side upper fastener (2) into right side top shock mount.
2. Insert left side upper fastener (3) into left side top shock mount.
3. Pivot shock absorbers to align lower shock mounts with mounting holes in rear fork.
4. Lift rear fork to meet lower shock mounts.
5. Thread left side lower fastener (1) and washer (5) through shock mount and rear fork into belt guard.
6. Thread right side lower fastener (1) and washer (5) through bottom shock mount in rear fork into thin height nut.
7. Tighten upper and lower shock mount fasteners to 41-68 Nm (31-50 ft-lbs).

⚠WARNING

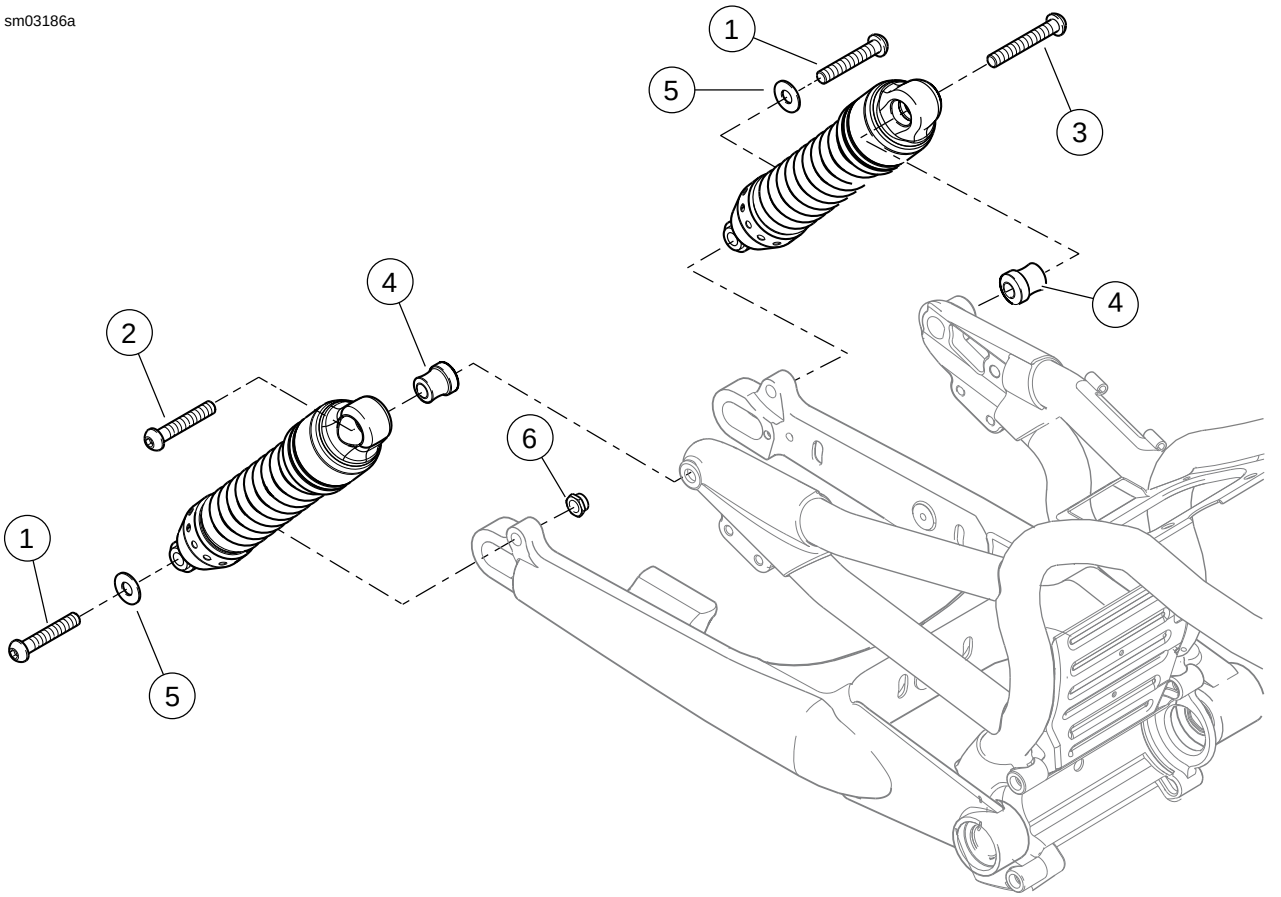
Adjust both shock absorbers equally. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036b)

8. Verify that preload settings on both shock absorbers are equal. See 1.18 SUSPENSION ADJUSTMENTS.

NOTE

Before setting up the suspension for carrying cargo refer to previous step and verify suspension adjustments.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Lower fasteners
2. Upper fastener, right side (60 mm)
3. Upper fastener, left side (70 mm)
4. Rubber shock damper spacer
5. Washer
6. Thin height hex-nut

TECHNICIAN II
HARLEY-DAVIDSON

Figure 2-125. Rear Shock Absorbers

REAR FORK 2.37

REMOVAL

NOTE

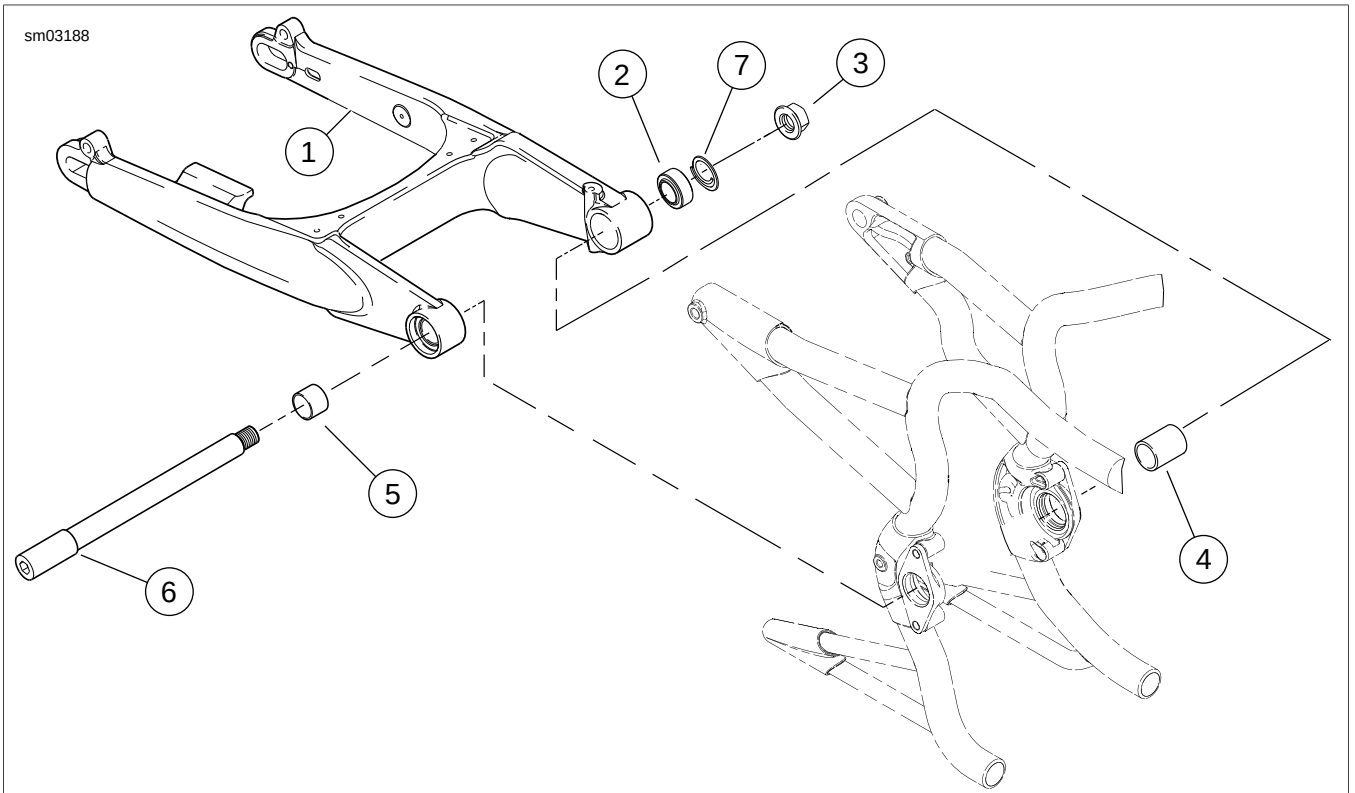
Mark all hardware as it is removed so that it may be returned to its original location.

1. Remove right side cover and main fuse.
2. Remove belt guard and debris deflector. See 2.35 BELT GUARD AND DEBRIS DEFLECTOR.
3. Remove rear wheel. See 2.26 REAR WHEEL.
4. Remove rear brake caliper brake fluid line and wheel speed sensor harness (ABS models only) from clips on rear rear fork. See 2.20 REAR BRAKE CALIPER.
5. Remove left lower rear shock absorber bolt. Remove right rear shock absorber bolt and thin height nut. See 2.36 REAR SHOCK ABSORBERS.

NOTE

Block or support engine before removing pivot shaft. Pivot bearing (2) will stay with rear fork when rear fork is removed from motorcycle.

6. See Figure 2-126. Remove pivot shaft nut (3).
7. Support rear fork (1) and slide pivot shaft (6) out. Rear fork can now be removed from frame.



1. **Rear fork**
2. **Left pivot bearing assembly**
3. **Nut**
4. **Left spacer**
5. **Right spacer**
6. **Pivot shaft**
7. **Lock ring**

Figure 2-126. Rear Fork (typical)

DISASSEMBLY AND ASSEMBLY

PART NUMBER	TOOL NAME
HD-44060-4	WHEEL BEARING REMOVAL/REPLACEMENT KIT
HD-47175	SWINGARM BEARING INSTALLATION TOOL

NOTES

- *Remove left pivot bearing assembly from fork only if replacement is required. the complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.*
- *The rear fork has been designed to incorporate a lock ring that MUST be removed before attempting to remove the left-side bearing. Using a small screwdriver or pick, catch the end of lock ring and remove ring from rear fork in a spiral fashion as shown in the following figures.*



Figure 2-127. Remove Nut and Axle



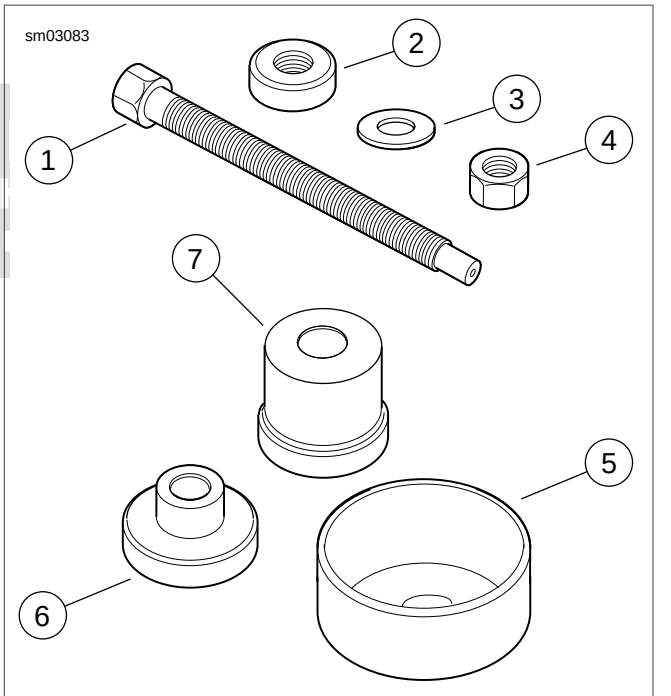
Figure 2-128. Locate End of Lock Ring



Figure 2-129. Slowly spiral ring out of groove

General

The SWINGARM BEARING INSTALLATION TOOL (Part No. HD-47175) is used with parts from WHEEL BEARING REMOVAL/REPLACEMENT KIT (Part No. HD-44060-4) as shown in Figure 2-130. Parts used are forcing screw (1), bearing (2), washer (3) and nut (4) to replace the rear fork bearings.



1. **Forcing screw**
2. **Bearing**
3. **Washer**
4. **Nut**
5. **Removal cup**
6. **Swingarm bearing remover/installer**
7. **Bushing remover/installer**

Figure 2-130. Parts Used From HD-44060-4 Kit (1-4) and Swingarm Bearing Installation Tool

NOTE

Always remove the bearing/bushing from the inside of rear fork going outward (see arrows). When installing rear bearings/bushings, install from the outside going inward (see arrows).

1. Remove rear fork. See 2.37 REAR FORK, Removal.

NOTE

When mounting rear fork in holding device, protect rear fork to avoid finish damage.

2. Place rear fork assembly on a suitable work surface in suitable holding device.

Left Side Rear Fork Bearing Removal

1. See Figure 2-131. Position removal cup against inner left arm of rear fork with cupped side facing rear fork
2. Install forcing screw through small hole in removal cup.
3. Install SWINGARM BEARING INSTALLATION TOOL (Part No. HD-47175), bearing, washer and nut.
4. Tighten forcing screw until bearing pulls free from rear fork housing.
5. Once bearing has been removed from rear fork, disassemble tool and remove components from rear fork. Discard old rear fork bearing.



Figure 2-131. Remove Left Side Swingarm Bearing (typical)

Left Side Rear Fork Bearing Installation

NOTE

Do not tighten tool past the point of seating the rear fork bearing or bearing damage can result.

1. See Figure 2-132. Load **new** rear fork bearing onto Swingarm Bearing Remover/Installer and insert into rear fork.
2. Install forcing screw through small hole in Swingarm Bearing Remover/Installer.
3. Position removal cup against inner left arm of rear fork with cupped side facing rear fork.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

NOTE

When installing bearing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.

6. Tighten tool until bearing seats in rear fork housing. DO NOT overtighten.
7. Loosen and remove tool.
8. Check rear fork bearing for free movement.



Figure 2-132. Install Left Side Swingarm Bearing (typical)

Right Side Bushing Removal

1. See Figure 2-133. Position removal cup against outer right arm of rear fork with cupped side facing rear fork.
2. Install forcing screw through small hole in removal cup.
3. Install bushing remover/installer, bearing, washer and nut.
4. Tighten forcing screw until bushing pulls free from rear fork housing.
5. Once bushing has been removed from rear fork, disassemble tool and remove components from rear fork. Discard old bushing.

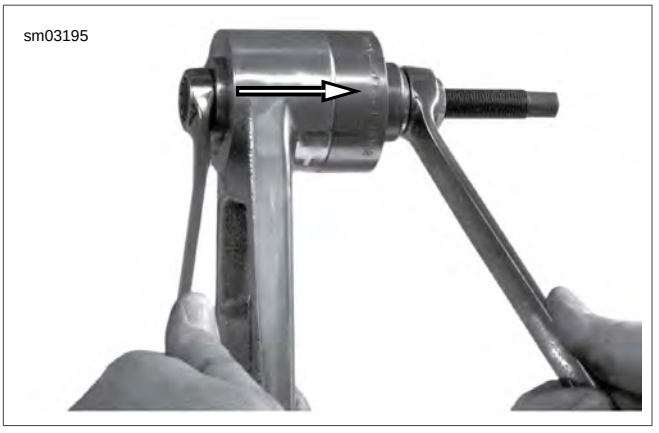


Figure 2-133. Remove Right Side Bushing (typical)

Right Side Bearing Installation

1. See Figure 2-134. Load **new** bushing onto bushing remover/installer and insert into outer side of right rear fork.

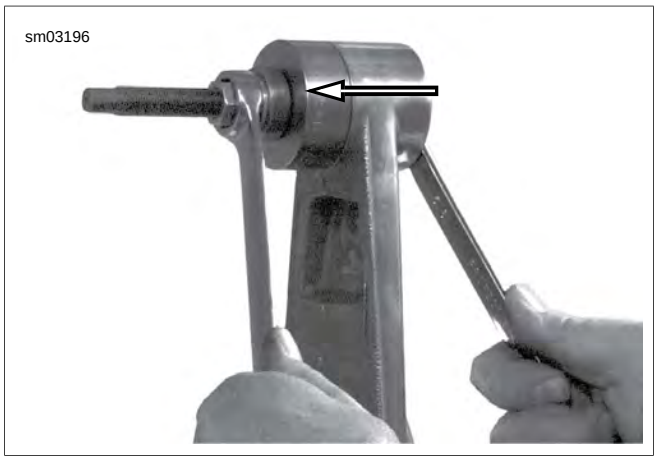


Figure 2-134. Install Right Side Bushing (typical)

2. Install forcing screw through small hole in bushing remover/installer.
3. Position removal cup against outer left arm of rear fork with cupped side facing rear fork.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

NOTE

When installing bushing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.

6. Tighten tool until bushing is at desired position in rear fork housing.
7. Loosen and remove tool.

NOTE

When installing bushing, tighten tool and begin installation process, stop and back tool off after a few turns and view how far the bushing has been pressed into the swing arm assembly. Bushing should be evenly centered between beveled edges of rear fork casting.

8. Check position of bushing in rear fork housing.
9. See Figure 2-135. Slowly spiral lock ring into recess in rear fork using a clockwise turning motion.



Figure 2-135. Insert Lock Ring

10. See Figure 2-136. Verify that lock ring has completely seated in rear fork.

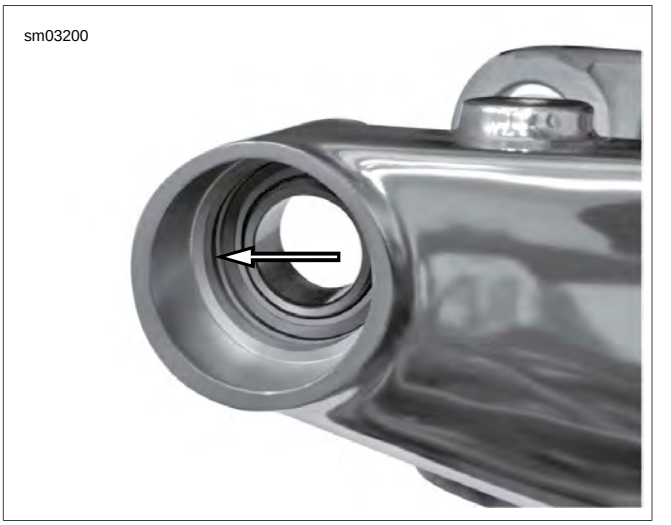


Figure 2-136. Lock Ring Fully Seated

INSTALLATION

PART NUMBER	TOOL NAME
HD-47176	SWINGARM GUIDE

FASTENER	TORQUE VALUE	
Pivot shaft nut	61-75 Nm	45-55 ft-lbs

1. See Figure 2-137. Install SWINGARM GUIDE (Part No. HD-47176) into pivot shaft cavity in frame.

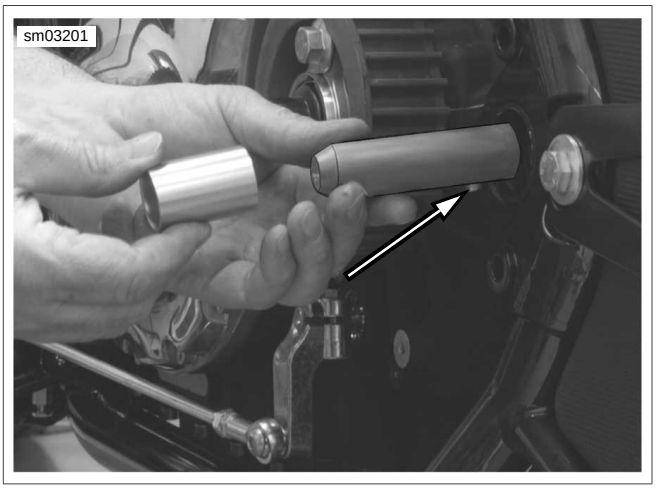


Figure 2-137. Install Swingarm Guide

2. See Figure 2-138. Slide left-side external rear fork spacer onto swingarm guide.

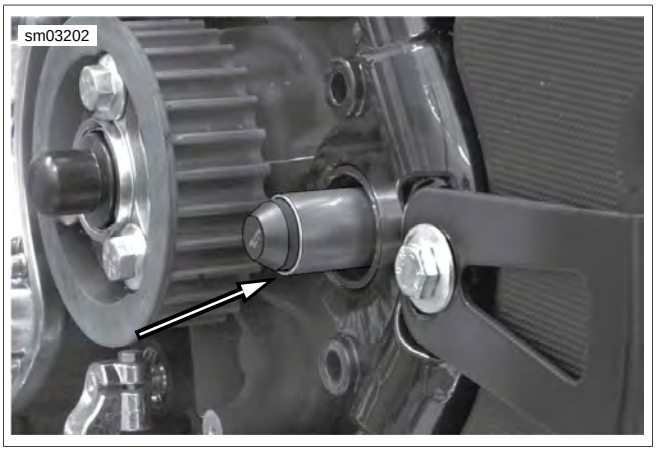


Figure 2-138. Install Left Spacer

3. See Figure 2-139. Push swingarm guide flush with face of left side spacer.



Figure 2-139. Push Guide flush with Spacer

NOTE

When installing rear rear fork and inserting rear fork pivot shaft, rear fork assembly guide will stick to threaded end of pivot shaft via magnet.

4. Install rear fork.
5. Slide rear fork assembly into position.
6. Apply a liberal coat of ANTI-SEIZE LUBRICANT to pivot shaft.
7. See Figure 2-126. From right side, slide pivot shaft (6) through dust seals, rear fork pivot bearing, bushing and engine mounts, spacers.
8. Apply two or three drops of LOCTITE 243 MEDIUM STRENGTH THREADLOCKER AND SEALANT (blue) to threads of pivot shaft. Install and tighten pivot shaft nut to 61-75 Nm (45-55 ft-lbs).

NOTE

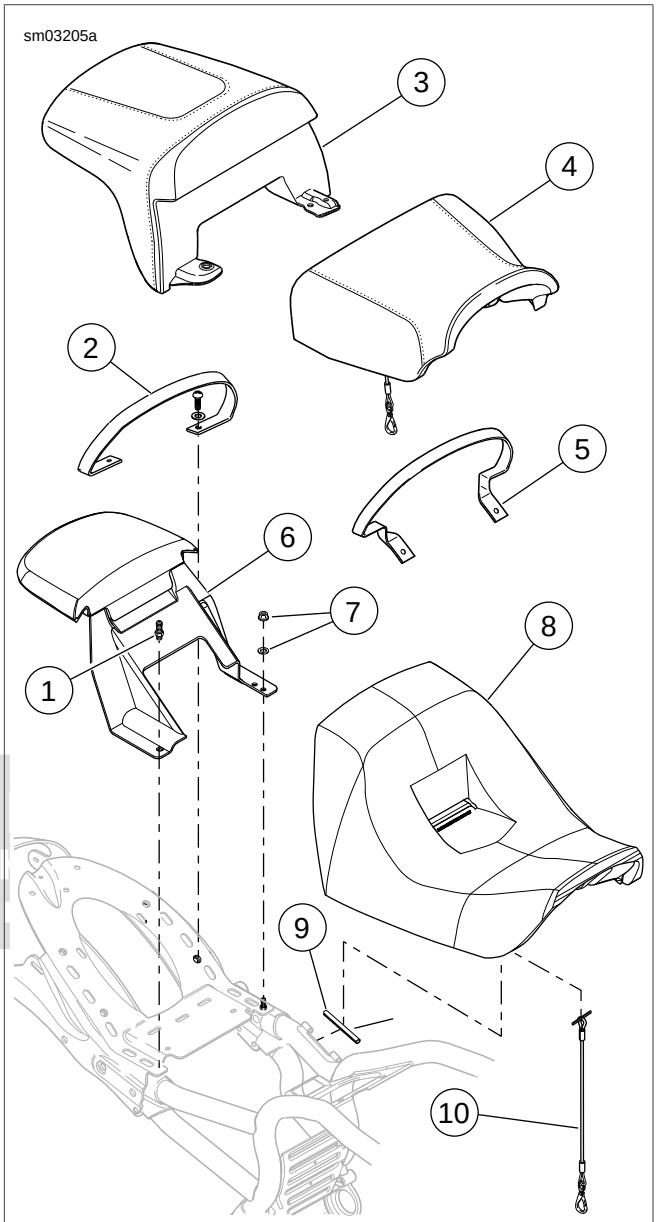
Proper pivot shaft tightening is important to maintain rear fork alignment.

9. Check for freedom of rotation of rear fork around bearings and that fork and frame side rails have not been distorted when pivot shaft nut was tightened.
10. Install both rear shock absorbers. See 2.36 REAR SHOCK ABSORBERS.
11. Install rear brake caliper and clip brake line and wheel speed sensor harness (ABS models only) to rear fork.
12. Install rear wheel.
13. Install belt guard and debris deflector. See 2.35 BELT GUARD AND DEBRIS DEFLECTOR.
14. Install main fuse and right side cover.

SEAT 2.38

REMOVAL

1. Open seat.
2. See Figure 2-140. Remove seat lanyard (10) from the hole in frame.
3. Pry hinge clip from seat hinge pins. Slide seat rearward to release hinge pins from bushings on frame.
4. Remove pillion mounting nut and washer (7).
5. Remove seat retaining post (1).
6. Slide grabstrap (2, 5) forward off pillion.
7. Push pillion forward to release slot on the bottom of pillion from tongue on fender. Lift pillion back and away from motorcycle.
8. If necessary, remove grabstrap.



1. **Seat retaining post**
2. **Grabstrap (VRSCF)**
3. **Pillion (VRSCF)**
4. **Rider's seat (VRSCF)**
5. **Grabstrap (VRSCDX)**
6. **Pillion (VRSCF)**
7. **Mounting nut and washer**
8. **Rider's seat (VRSCDX)**
9. **Hinge**
10. **Lanyard**

Figure 2-140. Seat and Pillion

CLEANING AND INSPECTION

1. Inspect all components for wear or damage.
2. Clean underside of pillion and seat. Clean fender and frame mounting surfaces.

NOTE

Do not use ordinary soap to clean the seat. Thoroughly clean with a quality saddle soap. Once the seat is dry, it can be treated with HARLEY-DAVIDSON LEATHER DRESSING.

INSTALLATION

FASTENER	TORQUE VALUE	
Grabstrap	20-26 Nm	14-19 ft-lbs
Pillion mounting nut	6-10 Nm	53-88 **in-lbs**
Seat retaining post	6-10 Nm	53-88 **in-lbs**

NOTE

See Figure 2-140. On VRSCDX models, ends of grabstrap (5) must face forward for proper pillion fit.

1. If necessary, install grabstrap. Tighten to 20-26 Nm (14-19 ft-lbs).
2. Push pillion toward front of motorcycle until mounting hole in pillion base is approximately 25 mm (1 in.) in front of tongue on fender.
3. While applying downward pressure on middle of pillion, slide pillion rearward to fully engage slot on bottom with tongue on top of fender. Push rearward until mounting hole on pillion base is aligned with mounting hole in frame.
4. Install pillion base to frame. Tighten fastener to 6-10 Nm (53-88 **in-lbs**).
5. Install seat retaining post. Tighten to 6-10 Nm (53-88 **in-lbs**).
6. Install seat. Make sure seat retaining post engages bushing in riders seat.
7. Press clip over seat hinge.
8. Install seat lanyard in original location.

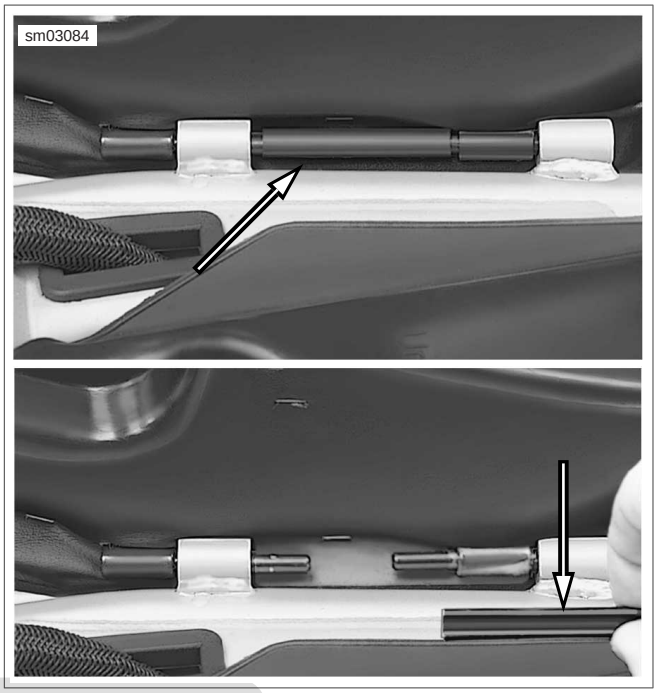


Figure 2-141. Seat Hinge and Clip (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

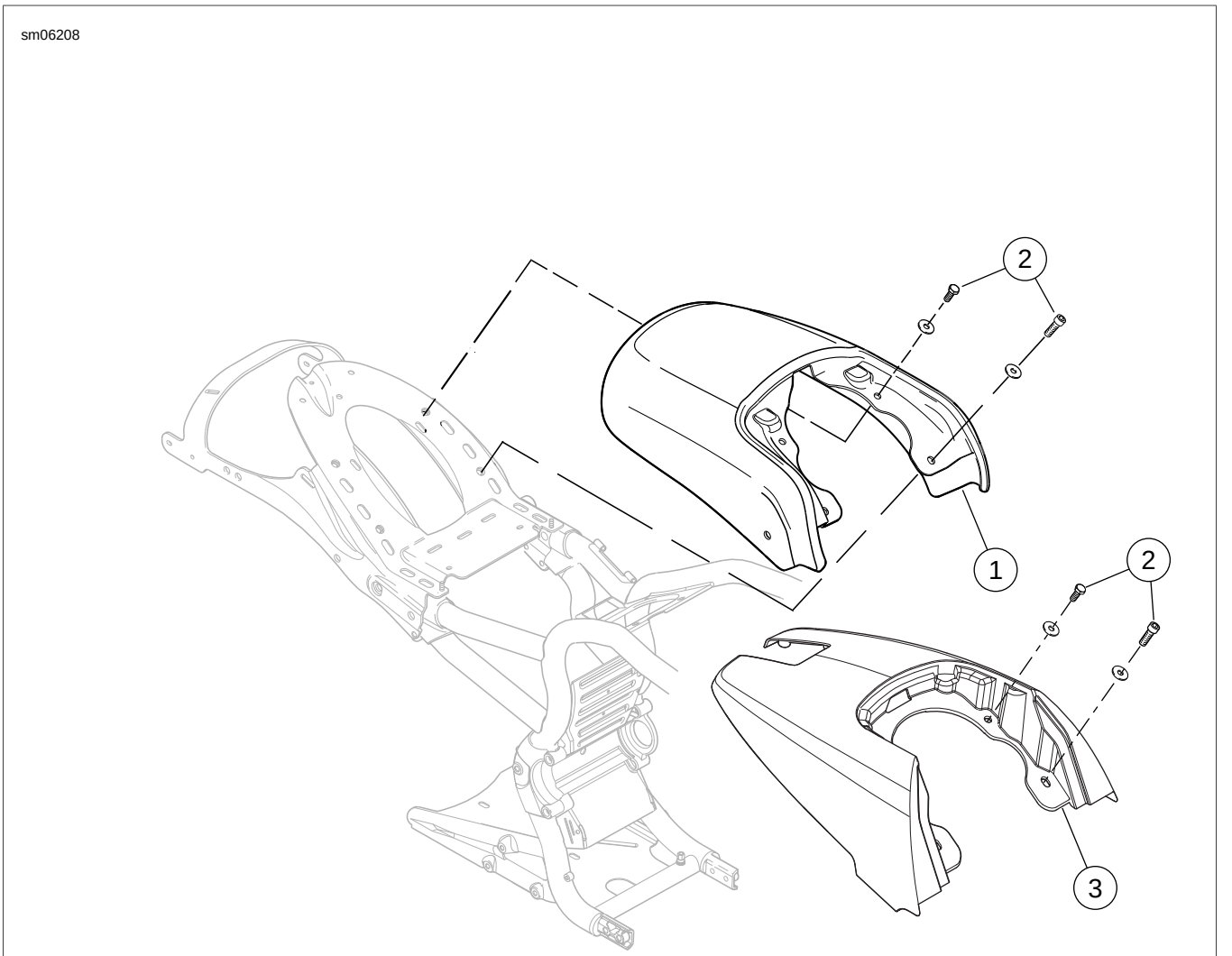
REAR FENDER 2.39

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove right side cover.
2. Remove main fuse.
3. Remove passenger pillion. See 2.38 SEAT.



1. **Rear fender: VRSCF, outer**
2. **Screws, rear fender mounting (4)**
3. **Rear fender: VRSCDX, outer**

Figure 2-142. Rear Fender

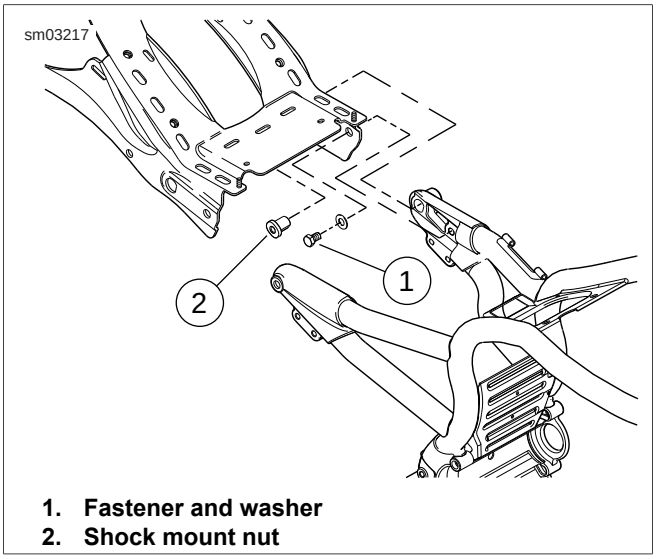
4. **On VRSCF models:** Disconnect rear turn signals [94B], tail/stop lamp [93B] and license lamp [233].
5. **On VRSCDX models:** Disconnect turn signal license plate assembly connector [94] and tail stop lamp connector [93].
6. See Figure 2-142. Remove electrical caddy and four fasteners (2) and washers from fender. Remove rear fender.

NOTE

Tail lamp cannot be removed with fender mounted to vehicle.

7. Once the fender has been removed, place fender upside down on a protected surface and remove tail lamp assembly.
8. **On VRSCF models:** See 7.15 TAIL LAMP: VRSCF.

9. **On VRSCDX models:** See 7.14 TAIL LAMP: VRSCDX and 7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX.



1. **Fastener and washer**
2. **Shock mount nut**

Figure 2-143. Inner Fender Fasteners

10. See Figure 2-143. Remove inner fender by removing rear shocks and fasteners shown.

INSTALLATION

FASTENER	TORQUE VALUE	
Fender, inner fasteners	95-110 Nm	75-81 ft-lbs
Fender mounting fasteners	20-26 Nm	15-19 ft-lbs
Passenger pillion fasteners	6-10 Nm	53-88 **in-lbs**

1. Install inner fender and fasteners only if inner fender was removed for replacement. Tighten fasteners to 95-110 Nm (75-81 ft-lbs).
2. Install rear shocks if removed for inner fender replacement. See 2.36 REAR SHOCK ABSORBERS.
3. Install tail lamp. See 7.15 TAIL LAMP: VRSCF or 7.14 TAIL LAMP: VRSCDX.

NOTES

- ***VRSCF Models:*** *When installing the rear fender, verify that you route the three connectors with their wiring harnesses through the low spot on the inner fender to make sure there is adequate clearance between the rear fender and the inner fender.*
- ***VRSCDX Models:*** *When installing the rear fender, verify that the wires are routed through the tunnel on the bottom side of the fender and secured with a cable strap. See 7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX.*

4. See Figure 2-142. Install rear fender by aligning fender with bolt holes on inner fender.

NOTE

On VRSCDX models: *Ends of grabstrap must face forward for proper pillion fit. See 2.38 SEAT.*

5. Install four fender fasteners. Tighten fasteners to 20-26 Nm (15-19 ft-lbs).
6. Install electrical caddy.
7. **On VRSCF models:** Connect rear turn signals [94B], tail/stop lamp [93B] and license lamp [233].
8. **On VRSCDX models:** Connect turn signal license plate assembly connector [94] and tail stop lamp connector [93].
9. Install passenger pillion. Tighten fasteners to 6-10 Nm (53-88 **in-lbs**).
10. Install main fuse and right side cover.

⚠WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

11. Test tail lamp and signals for proper operation.

LICENSE PLATE BRACKET: VRSCF 2.40

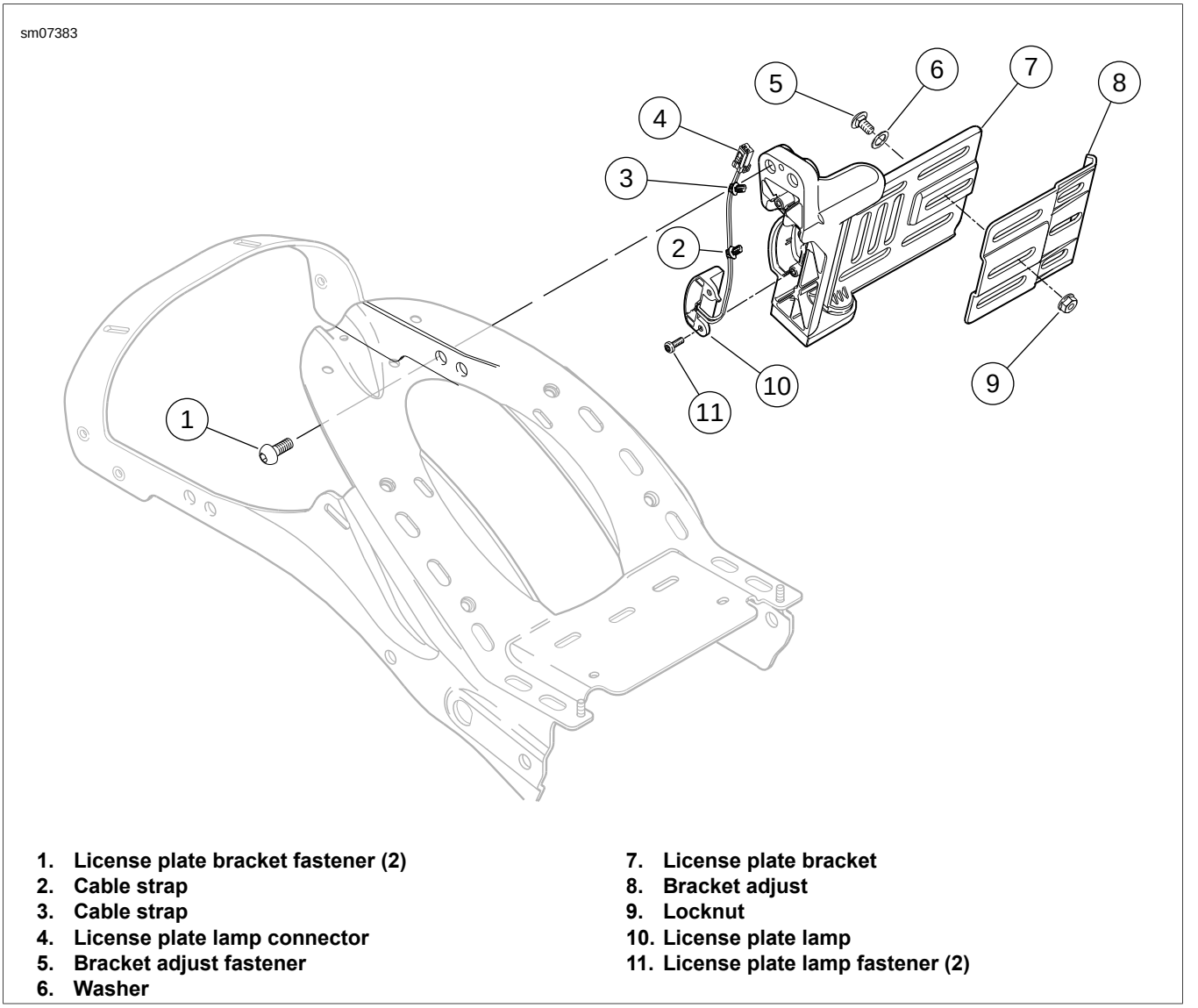
REMOVAL: DOMESTIC ONLY

1. Remove rear fender. See 2.39 REAR FENDER.
2. See Figure 2-144. Remove license plate bracket fasteners (1) securing license plate bracket (7) to frame.

NOTES

- *The license plate lamp assembly includes an LED. If the LED lamp fails, the assembly must be replaced.*
- *Note routing of license plate wiring and cable straps before removal.*

3. If necessary, remove license plate lamp (10).
 a. Disconnect connector (4) located on under seat electrical caddy.
 b. Remove wiring and cable straps from license plate bracket.
 c. Remove license plate lamp fasteners (11)



1. **License plate bracket fastener (2)**
2. **Cable strap**
3. **Cable strap**
4. **License plate lamp connector**
5. **Bracket adjust fastener**
6. **Washer**
7. **License plate bracket**
8. **Bracket adjust**
9. **Locknut**
10. **License plate lamp**
11. **License plate lamp fastener (2)**

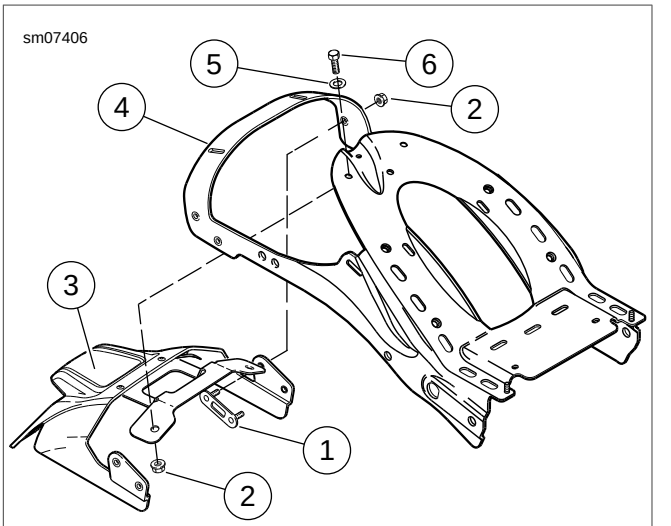
Figure 2-144. License Plate Bracket: VRSCF (DOM)

REMOVAL: NON-DOMESTIC

NOTES

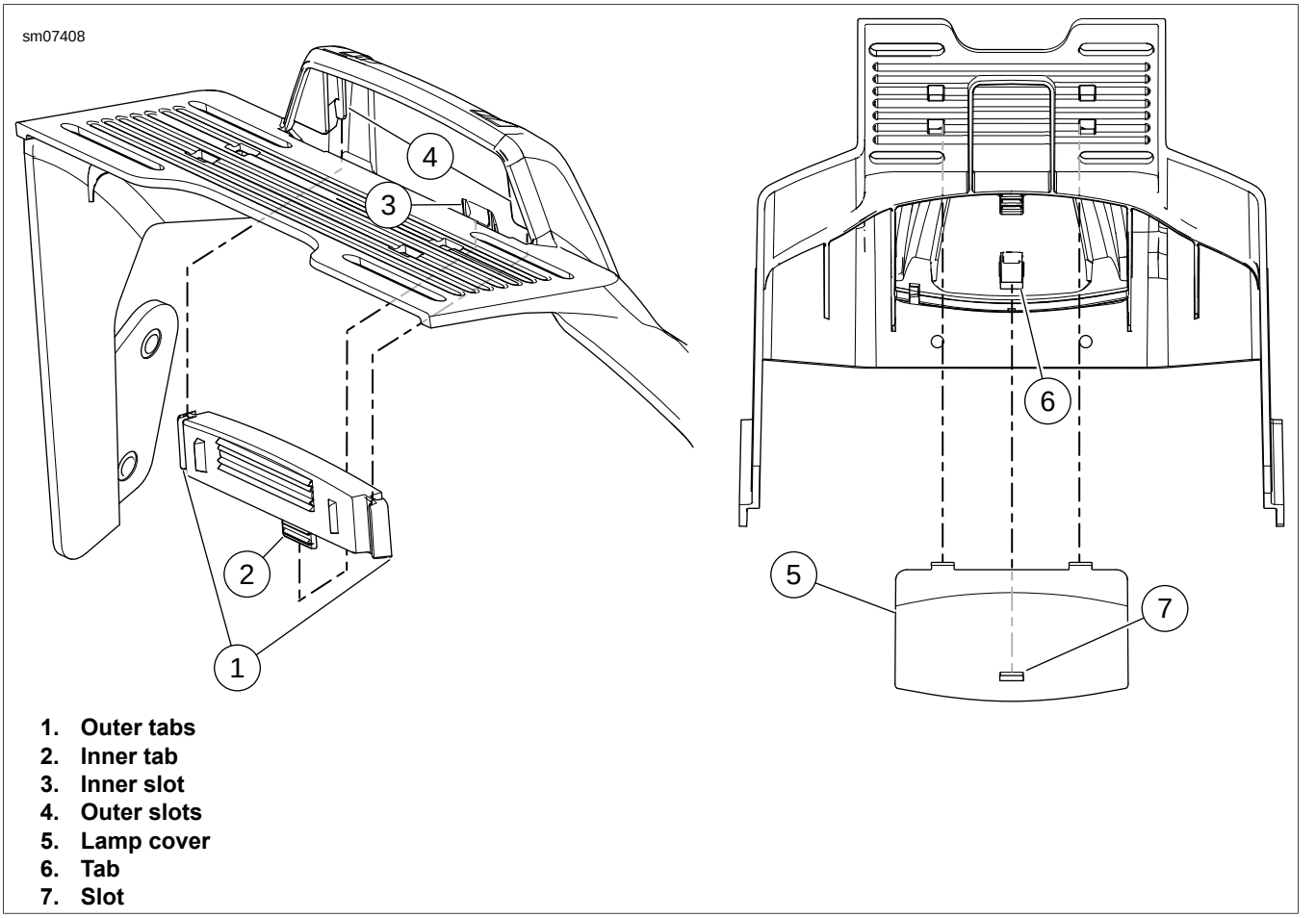
- *The license plate lamp assembly includes an LED. If the LED lamp fails, the assembly must be replaced.*
- *Note routing of license plate wiring and cable straps before removal.*

1. Remove rear fender. See 2.39 REAR FENDER.
2. Disconnect connector [45] located under seat electrical caddy.
3. Remove wiring and cable straps.
4. See Figure 2-145. Remove fasteners (6), washers (5) and nuts (2) securing license plate bracket (3) to frame (4).
5. Remove nuts (2) and stud plates (1).
6. If necessary, remove license plate lamp.
 a. See Figure 2-146. Lift lamp cover (5) slot (7) off of tab (6). Remove lamp cover.
 b. Lift inner tab (2) from inner slot (3) and slide license plate lamp from license plate bracket.



1. **Stud plate (2)**
2. **Nut (6)**
3. **License plate bracket**
4. **Frame**
5. **Washer (2)**
6. **Fastener (2)**

Figure 2-145. License Plate Bracket: VRSCF (Non-Dom)



1. **Outer tabs**
2. **Inner tab**
3. **Inner slot**
4. **Outer slots**
5. **Lamp cover**
6. **Tab**
7. **Slot**

Figure 2-146. License Plate Lamp: VRSCF (Non-DOM)

INSTALLATION: DOMESTIC ONLY

FASTENER	TORQUE VALUE	
License plate bracket fasteners (VRSCF-DOM)	9-11 Nm	80-97 **in-lbs**

1. See Figure 2-144. Install license plate lamp (10) to license plate bracket (7).
 a. Secure lamp with fasteners (11).
 b. Install **new** cable straps (2, 3) and route wiring in license plate bracket.
 c. Mate connector (4) to other half of connector located on under seat electrical caddy.
2. Install license plate bracket fasteners (1) securing license plate bracket (7) to frame. Tighten to 9-11 Nm (80-97 **in-lbs**).
3. Install rear fender. See 2.39 REAR FENDER.

INSTALLATION: NON-DOMESTIC

FASTENER	TORQUE VALUE	
License plate bracket fasteners (VRSCF) (Non-DOM)	8-12 Nm	70.7-106.1 **in-lbs**
Stud plate nuts	8-12 Nm	70.7-106.1 **in-lbs**

1. See Figure 2-146. Slide **new** license plate lamp into license plate bracket.
 a. Slide outer tabs (1) of license plate lamp on outer slots (4) of license plate bracket.
 b. Install lamp until inner tab (2) engages inner slot (3).
2. See Figure 2-145. Place license plate bracket in position under frame.
3. Install stud plates (1) and nuts (2). Do not tighten.
4. Install washers (5), fasteners (6) and nuts (2). Tighten nuts to 8-12 Nm (70.7-106.1 **in-lbs**).
5. Tighten stud plate nuts to 8-12 Nm (70.7-106.1 **in-lbs**).
6. Install **new** cable straps and route wiring to under seat caddy.
7. Mate connector [45] to other half of connector located on under seat electrical caddy.
8. Install rear fender. See 2.39 REAR FENDER.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

JIFFY STAND 2.41

CLEANING

WARNING

The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)

WARNING

Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)

WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)

1. Raise motorcycle underneath frame with a suitable lifting device so both wheels are raised off ground.
2. See Figure 2-148. Inspect leg stop and lock slot in jiffy stand weldment. If covered or plugged with dirt, wipe dirt off with a shop towel.
3. Spray catch and mating surface with LOCTITE AEROSOL ANTI-SEIZE.
4. Move jiffy stand leg forward and back while spraying anti-seize to infuse LOCTITE AEROSOL ANTI-SEIZE into mating parts.
5. Check condition of rubber bumper.

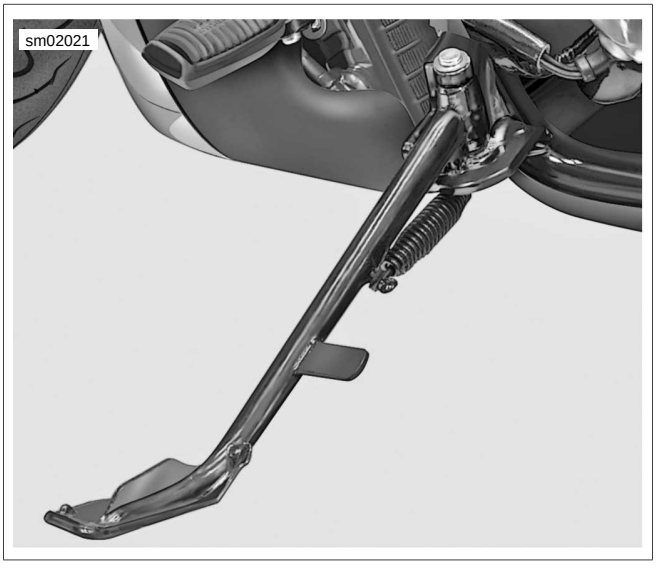


Figure 2-147. Jiffy Stand (Typical)

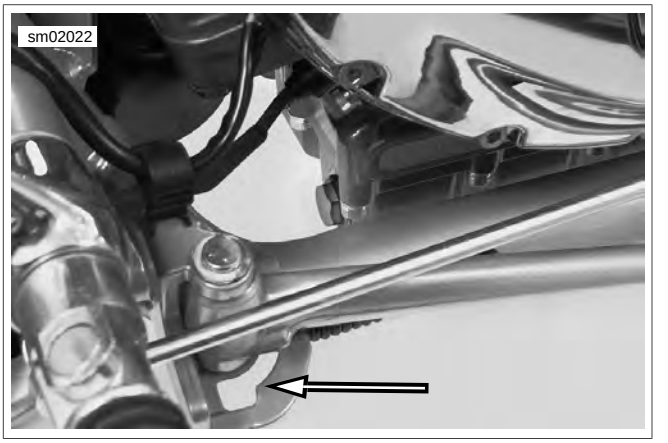


Figure 2-148. Jiffy Stand Catch and Lock Slot

JIFFY STAND INTERLOCK: INTERNATIONAL MODELS

Some international models are equipped with a jiffy stand interlock feature.

The vehicle will start and run with the jiffy stand down while the transmission is in neutral. If the jiffy stand is down, the transmission is in gear, and the clutch is released, the vehicle will stall. The message "SidE StAnd" will scroll across the odometer to indicate this to the rider. Raising the jiffy stand (or putting the transmission in neutral) will permit the engine to run and clear the message.

If the jiffy stand moves out of the fully retracted position while riding at speeds greater than 15 km/h (10 mph), then the jiffy stand interlock system will maintain engine operation and alert the rider about this by illuminating the indicators (flash twice) and scroll the message "SidE StAnd" across the odometer. The message will remain until the system detects the jiffy stand in the fully retracted position again. The rider may continue to operate the vehicle while in this mode.

The rider may clear the text messages at any time by pressing the function switch once while the vehicle is powered up.

REMOVAL

WARNING

Block or jack vehicle under frame in a way that the vehicle will not fall over. Failure to properly block and/or raise the vehicle could result in death or serious injury. (00462c)

1. Raise motorcycle underneath frame with a suitable lifting device so both wheels are raised off ground. Jiffy stand should be able to move through its full range of travel without the weight of motorcycle resting on it.
2. See Figure 2-150. Remove cotter pin (3) from clevis pin (2).

NOTE

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring ten-

sion could cause the spring, attached components and/or hand tools to fly outward.

3. With leg in the retracted position, detach spring (6) from jiffy stand leg (5), and anchor (7).
4. Remove clevis pin (2) by gently tapping on pin from bottom to drive pin up through mounting bracket.
5. Pull out jiffy stand leg and remove upper and lower bushings.
6. Loosen and remove the anchor (7).
7. Remove rubber bumper (1), if necessary.

NOTE

Jiffy stand brackets can be replaced by replacing the left lower frame rail. See 2.4 LOWER FRAME RAILS.

INSTALLATION

FASTENER	TORQUE VALUE	
Jiffy stand anchor	7-9 Nm	62-79 **in-lbs**

1. See Figure 2-150. Apply LOCTITE 243 MEDIUM STRENGTH THREADLOCKER AND SEALANT (blue) to anchor (7). Install and tighten anchor to 7-9 Nm (62-79 **in-lbs**).
2. Apply AEROSOL ANTI-SEIZE LUBRICANT to both bushings (4) and install bushings in position for a retracted leg.
3. Orient leg retracted in mounting bracket, and install **new** clevis pin (2) through the upper bushing (4), leg (5), and lower bushing (4).
4. Install **new** cotter pin (3).
5. Attach spring (6) to the anchor and to jiffy stand leg (5). When properly installed, spring open hook on anchor faces outward and open hook on jiffy stand leg faces down when jiffy stand leg is extended.
6. Replace rubber bumper (1) if required.
7. Check that jiffy stand operates correctly before supporting the weight of the motorcycle on the leg.

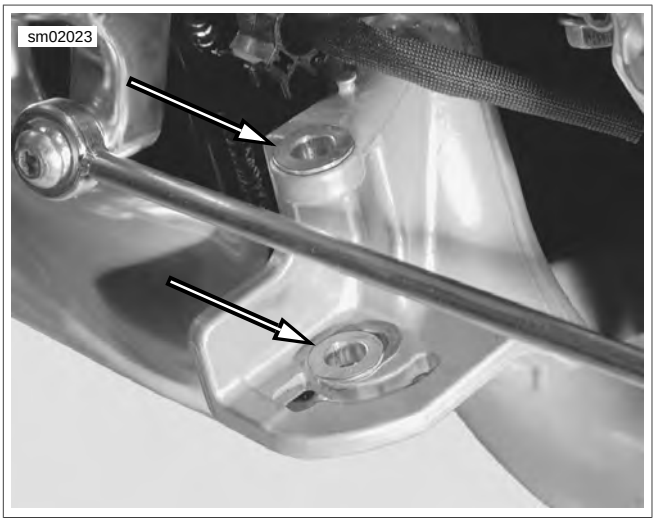
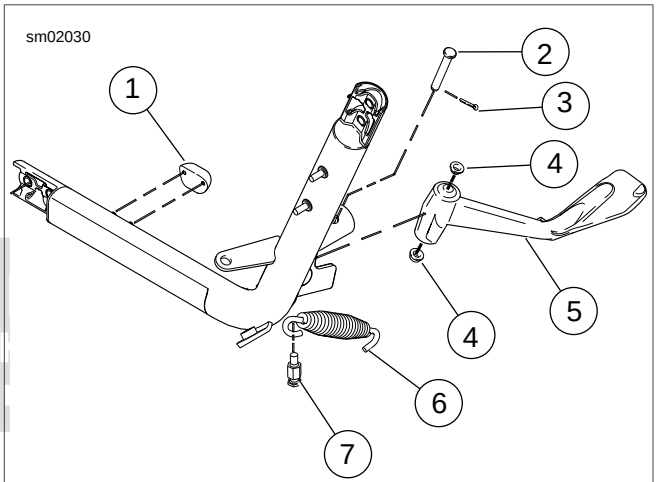


Figure 2-149. Bushings in Retracted Position



1. **Rubber bumper**
2. **Clevis pin**
3. **Cotter pin**
4. **Bushings (2)**
5. **Leg**
6. **Spring**
7. **Anchor**

Figure 2-150. Jiffy Stand Components (typical)

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NOTES

FASTENER TORQUE VALUES 3.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten to specification plus 90 degrees
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten to specification plus 90 degrees
* Cylinder head bolts; first torque then loosen one turn	35 Nm	26 ft-lbs	3.10 CYLINDER HEAD, Installation/Loosen one full turn then final tighten.
* Cylinder head bolts; second torque	20 Nm	15 ft-lbs	3.10 CYLINDER HEAD, Installation/Tighten to specification plus an additional 90 degrees
* Primary gear fasteners; specification plus 60 degrees	15 Nm	132 **in-lbs**	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten in a crisscross pattern plus 60 degrees.
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Cam chain tensioner, secondary	100 Nm	74 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam chain tensioner, secondary	100 Nm	74 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam cover fasteners	11 Nm	97 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing/Special method: Install in sequence: cable straps first, spark plug hole gasket second
Cam journal caps	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam journal caps	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam journal caps	9.7 Nm	86 **in-lbs**	3.10 CYLINDER HEAD, Head Assembly
Camshaft sprocket fasteners	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Head bolts, 6 mm	9.7 Nm	86 **in-lbs**	3.10 CYLINDER HEAD, Installation
Oil filter mount fasteners	9.7 Nm	86 **in-lbs**	3.14 OIL FILTER MOUNT, Removal/Installation
Oil pump fasteners	9.7 Nm	86 **in-lbs**	3.13 OIL PUMP, Removal/Installation
Primary chain fixed tensioner fastener	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Primary chain hydraulic tensioner fasteners	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation

FASTENER	TORQUE VALUE		NOTES
Spark plugs	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Starter limiter assembly fastener	46 Nm	34 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Triple sprocket fastener	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

SPECIFICATIONS: ENGINE 3.2

GENERAL

Table 3-1. Cam Drive

ITEM	DATA
Number of cylinders	2
Type	4-cycle, 60 degree, liquid cooled V-twin
Bore	105 mm (4.13 in)
Stroke	72 mm (2.84 in)
Piston displacement (approx.)	1250 cc (76 cubic in)
Max. engine speed	9000 RPM
Idle speed	1250 rpm (1400 rpm Japan)
Engine and transmission weight	89.4 kg (197 lbs)

Table 3-2. Oil Pump

ITEM	DATA
Type	Gerotor, internal oil pump, wet sump
Pressure	296.5-648.1 kPa (43-94 psi) at 3000 RPM and normal operating temperature of 70 °C (158 °F)
Filtration	10 micron media between pump and engine

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Table 3-3. Water Pump

ITEM	DATA
Type	Impeller type, thermostat controlled bypass

Table 3-4. Valve Diameter

ITEM	MM	IN
Intake	40.0	1.575
Exhaust	34.5	1.358

Table 3-5. Valve Lash

ITEM		MM	IN
Intake	Max	0.245	0.0096
	Min	0.195	0.0078
Exhaust	Max	0.345	0.0135
	Min	0.295	0.0117

Table 3-6. Cylinder Heads

ITEM	MM	IN
Valve guide in head (interference fit)	Max 0.051	0.002
	Min 0.022	0.0009
Valve seat in head (interference fit)	Max 0.100	0.0039
	Min 0.059	0.002
Valve guide I.D.	Max 6.015	0.2368
	Min 6.000	0.2362
Valve stem diameter	Intake	
	Max 5.9715	0.2351
	Min 5.9565	0.2345
	Exhaust	
	Max 5.9615	0.2347
	Min 5.9465	0.2341
Valve to guide running clearance	Intake	
	Max 0.0585	0.0023
	Min 0.0285	0.0011
	Exhaust	
	Max 0.0685	0.0027
	Min 0.0385	0.0015
Valve seat to cylinder head press	Max 0.0100	0.0004
	Min 0.0590	0.0023
Valve seat run-out	Max 0.0050	0.0002
Valve seat to guide run-out	Max 0.0200	0.0008
Cylinder head flatness	Max 0.0200	0.0008
Intake valve stem protrusion	Max 44.771	1.762
	Min 44.171	1.739
Exhaust valve stem protrusion	Max 43.893	1.728
	Min 43.293	1.704

Table 3-7. Valve Springs

ITEM	METRIC	SAE
Valve spring free length	Outer	
	45.63 mm	1.797 in
	Inner	
	43.77 mm	1.723 in
Valve spring installed height	Outer	
	Max 39.00 mm	1.535 in
	Inner	
	Max 37.00 mm	1.457 in
Spring force installed	Outer @ 39 mm (1.535 in) max	
	Max 20.80 kgf	45.86 lbf
	Min 18.97 kgf	41.82 lbf
	Inner @ 37 mm (1.457 in) max	
	Max 11.31 kgf	24.95 lbf
	Min 10.10 kgf	22.27 lbf
Spring force compressed	Outer @ 28 mm (1.10 in)	
	Max 66.59 kgf	146.8 lbf
	Min 60.88 kgf	134.2 lbf
	Inner @ 26 mm (1.02 in)	
	Max 34.15 kgf	75.3 lbf
	Min 32.63 kgf	71.9 lbf

Table 3-8. Cam Drive

ITEM	DATA
Intake	112 degree
Exhaust	106 degree
Total intake lift	10.9 mm (0.4291 in.)
Duration, intake @ 1 mm	248 degree
Total exhaust lift	9.98 mm (0.3929 in.)
Duration, exhaust @ 1 mm	206 degree

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Table 3-9. Piston Ring Gap

ITEM	DATA
Top ring gap (maximum)	0.550 mm (0.022 in.)
Top ring gap (minimum)	0.350 mm (0.014 in.)
2nd ring gap (maximum)	0.650 mm (0.026 in.)
2nd ring gap (minimum)	0.400 mm (0.016 in.)
Oil control ring (maximum)	0.890 mm (0.035 in)
Oil control ring (minimum)	0.380 mm (0.015 in.)
Top ring side clearance (maximum)	0.077 mm (0.003 in.)
Top ring side clearance (minimum)	0.032 mm (0.001 in.)
2nd ring side clearance (maximum)	0.075 mm (0.003 in.)
2nd ring side clearance (minimum)	0.030 mm (0.001 in.)

Table 3-10. Connecting Rod/Piston

ITEM	MM	IN
Rod small end bore dia.	Max 22.028	0.8672
	Min 22.018	0.8669
Piston pin diameter	Max 22.000	0.8661
	Min 21.995	0.8659
Running clearance	Max 0.033	0.0013
	Min 0.018	0.0007

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Table 3-11. Balance Shaft/Crankcase

	MM	IN
Balance shaft journal	Max 17.012	0.6698
	Min 17.001	0.6693
Press fit inner race to journal	Max -0.020	- 0.0008
	Min -0.001	- 0.0000
Crankcase balance shaft bearing bore	Max 39.971	1.5737
	Min 39.955	1.5730
Bearing outer race to bearing bore press fit	Max -0.045	- 0.0018
	Min -0.018	- 0.0007

Table 3-12. Connecting Rod Journals

ITEM	MM	IN
Rod bearing journal	Red	
	Max 47.991	1.8894
	Min 47.983	1.8891
	Blue	
	Max 47.983	1.8891
	Min 47.975	1.8888
Rod bearing bore without bearing	Max 51.616	2.0321
	Min 51.600	2.0315
Rod bearing bore with bearing	Red	
	Max 48.052	1.8918
	Min 48.020	1.8906
	Blue	
	Max 48.044	1.8915
	Min 48.012	1.890
Running clearance	Max 0.069	0.0027
	Min 0.029	0.0011
Axial end play	Max 0.290	0.0114
	Min 0.140	0.0055

Table 3-13. Crankshaft/Crankcase

ITEM	ALTERNATOR SIDE		CLUTCH SIDE	
	MM	IN	MM	IN
Main bearing journal	Blue			
	Max 55.977	2.2038	Max 55.952	2.2028
	Min 55.971	2.20358	Min 55.946	2.20260
	Green			
	Max 55.984	2.20409	Max 55.959	2.20311
	Min 55.977	2.20382	Min 55.952	2.20283
	Red			
	Max 55.990	2.20433	Max 55.965	2.20334
	Min 55.984	2.20410	Min 55.959	2.20312
Main bearing bore	Max 61.019	2.40232		
	Min 61.000	2.40158		
Running clearance	Blue			
	Max 0.059	0.00232	Max 0.059	0.00232
	Min 0.026	0.00103	Min 0.026	0.00103
	Green			
	Max 0.061	0.00240	Max 0.061	0.00240
	Min 0.027	0.00107	Min 0.027	0.00107
	Red			
	Max 0.062	0.00244	Max 0.062	0.00244
	Min 0.029	0.00115	Min 0.029	0.00115
Axial end play	Max 0.060	0.00236		
	Min 0.050	0.00197		

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SERVICE WEAR LIMITS 3.3

GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

Table 3-14. Crankshaft/Crankcase

ITEM	ALTERNATOR SIDE		CLUTCH SIDE	
	MM	IN	MM	IN
Main bearing journal	Blue			
	Max 55.977	2.2038	Max 55.952	2.2028
	Min 55.971	2.20358	Min 55.946	2.20260
	Green			
	Max 55.984	2.20409	Max 55.959	2.20311
	Min 55.977	2.20382	Min 55.952	2.20283
	Red			
	Max 55.990	2.20433	Max 55.965	2.20334
	Min 55.984	2.20410	Min 55.959	2.20312
Main bearing bore	Max 61.019	2.40232		
	Min 61.000	2.40158		
Running clearance	Blue			
	Max 0.059	0.00232	Max 0.059	0.00232
	Min 0.026	0.00103	Min 0.026	0.00103
	Green			
	Max 0.061	0.00240	Max 0.061	0.00240
	Min 0.027	0.00107	Min 0.027	0.00107
	Red			
	Max 0.062	0.00244	Max 0.062	0.00244
	Min 0.029	0.00115	Min 0.029	0.00115
Axial end play	Max 0.060	0.00236		
	Min 0.050	0.00197		

Table 3-15. Crankshaft/Crankcase

ITEM	MM	IN
Main bearing journal	55.940	2.202
Axial end play	0.300	0.011
Main bearing bore	61.019	2.4023

Table 3-16. Connecting Rod/Piston

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Small end bore diameter	22.050	0.868
Piston pin diameter	21.996	0.866

Table 3-17. Connecting Rod/Crankshaft

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Rod bearing journal	47.970	1.888
Rod bearing bore	51.616	2.0321

Table 3-18. Piston/Cylinder Liner

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder liner i. d. bore (freestate)	105.085	4.1372
Cylinder liner out-of-round (installed)	0.080	0.0031
Piston major diameter	104.925	4.1309
Running clearance	0.080	0.0031

Table 3-19. Piston Rings

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Top ring gap	0.700	0.0276
2nd ring gap	0.800	0.03419
Oil control ring gap	1.050	0.0413
Top ring side clearance	0.100	0.0039
2nd ring side clearance	0.070	0.0028

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Table 3-20. Cylinder Heads

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder head flatness	0.100	0.0039
Cylinder head cam bore diameter	26.035	1.0250
Tappet bucket o.d. diameter	30.962	1.2190
Cylinder head bucket bore diameter	31.040	1.2220
Valve guide i.d. diameter	6.040	0.2378
Valve stem deflection	0.08	0.00315
Valve seat width - intake	1.700	0.0669
Valve seat width - exhaust	2.00	0.0787
Valve seat-to-guide runout	0.080	0.0031

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HOW TO USE THIS SECTION 3.4

TOP END REPAIR

Valve lash adjustment, secondary cam chain adjustment, cam drive inspection, front cylinder head removal and some part replacements can be done with the engine in chassis.

For all other top end repairs including rear cylinder head removal, the engine must be removed from the chassis. See 2.8 ENGINE REPLACEMENT.

BOTTOM END REPAIR

Bottom end repair can only be done with engine removed from chassis. See 2.8 ENGINE REPLACEMENT.

TYPICAL SYMPTOMS

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults. But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

Certain "knocking" noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both out of tolerance, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

Most frequently, valves, rings, piston pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

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OIL FLOW 3.5

GENERAL

The engine oil serves two purposes. First, the oil lubricates all of the metal to metal parts that are in motion relative to each other. Second, the oil cools the engine, specifically, the pistons.

See Figure 3-1. As the oil is warmed to normal operating temperature, the oil is scavenged from the sump at the screened pick up (1) by the oil pump (2).

The oil pump (2) pressurizes the oil and the pressure maintains the flow of oil through the engine. The oil flows through a bypass valve and through the oil passages to the oil filter (3). If oil pressure exceeds 606.7 kPa (88 psi), the bypass valve is activated, rerouting oil back through the suction side of the oil pump.

The filtered oil flows into the oil lines up and over the top of the radiator/oil cooler assembly (via oil line) and down to the left side of the oil cooler (4). Flowing through the cooler, the cooled oil is routed up and over the radiator/oil cooler assembly (via oil line) and then down to the oil fitting (5) on the front of the crankcase.

At the crankcase oil fitting, oil is routed to three passages:

1. Oil entering the passage (6) on the water pump side lubricates the right main bearings. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the rear connecting rod journals.
2. Oil entering the middle passage (7) supplies oil to the front piston jet. The piston jets spray oil to cool the underside of the pistons.
3. See Figure 3-2. Oil entering the cam drive side passage (8) feeds the cam drive side main bearing. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the front connecting rod bearings.
4. From the cam drive side main bearing, the oil is routed in two directions:
 a. Oil is routed up to the cam drive triple gear bushing (9) where oil is routed along the shaft to the water pump impeller. The oil also flows to front cylinder head through an oil sending unit (10) which shuts off the oil pressure light when oil pressure reaches 13.8-34.5 kPa (2-5 psi). The oil passages continue on to the intake and exhaust cams (13) lubricating the cam journals through grooves in the bearings and to the secondary cam chain tensioner (12).
 b. The second set of passages from the cam drive side main bearings lead the oil flow to the primary cam chain tensioner and up to the secondary cam chain tensioner, the rear cylinder head and the rear intake and exhaust cam journals. From the primary cam chain tensioner the oil also branches to the rear piston jet to cool the underside of the rear piston. The final passages from the cam drive side main bearing routes oil back to the transmission and clutch where the oil lubricates and cools the transmission input and output shafts.
5. See Figure 3-3. Returning oil to the sump (19), the rear cylinder head drains onto the clutch (16) to lubricate primary gear and clutch assembly. Oil from the rear cylinder head also drains on the transmission input and output shaft gearset (16) where gear meshing transfers oil to all gears and then drains into the oil sump (17).
6. The oil in the front cylinder head drains down the cylinder head drain passage (18) to the sump (19).

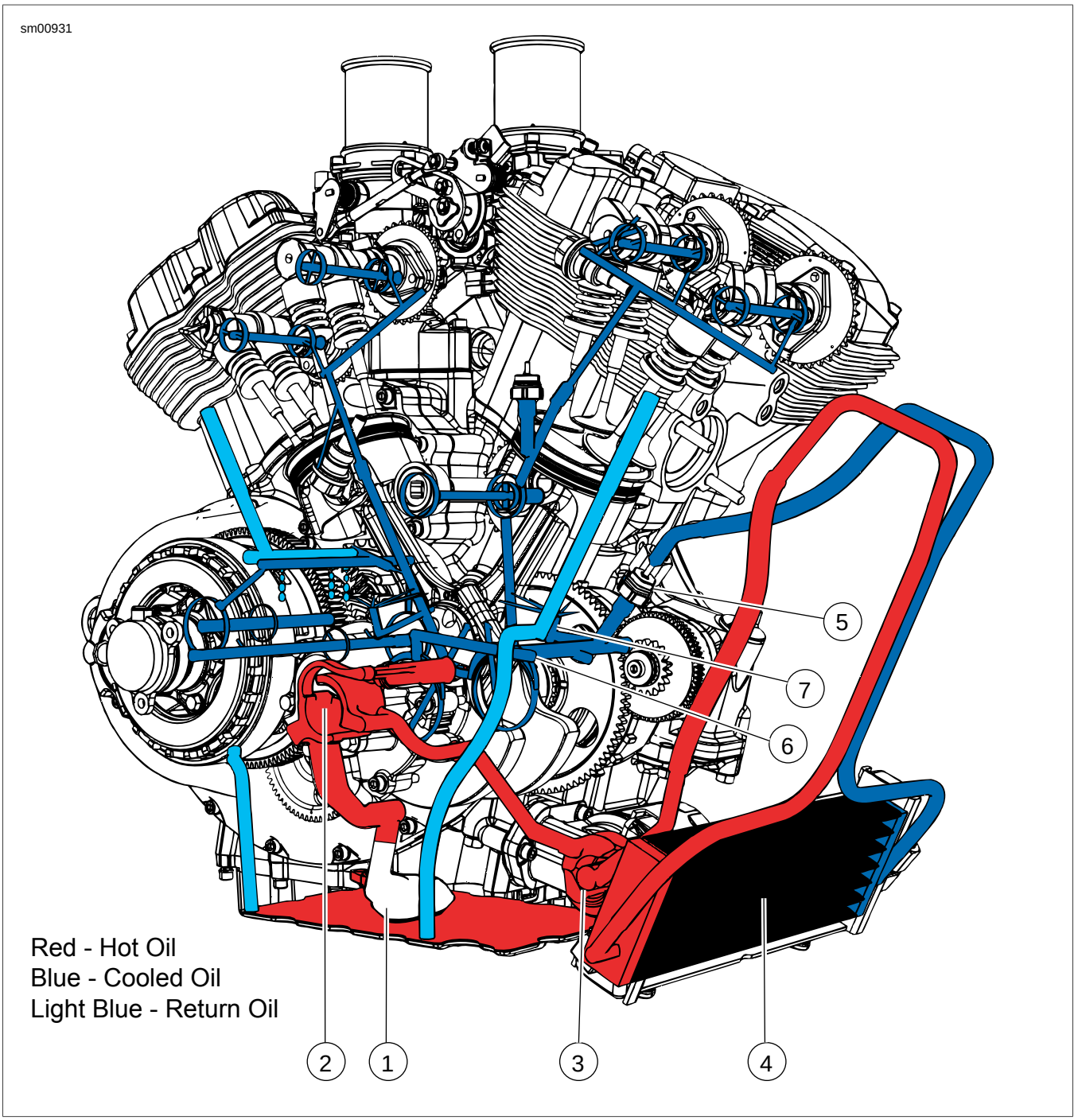


Figure 3-1. Oil Flow A

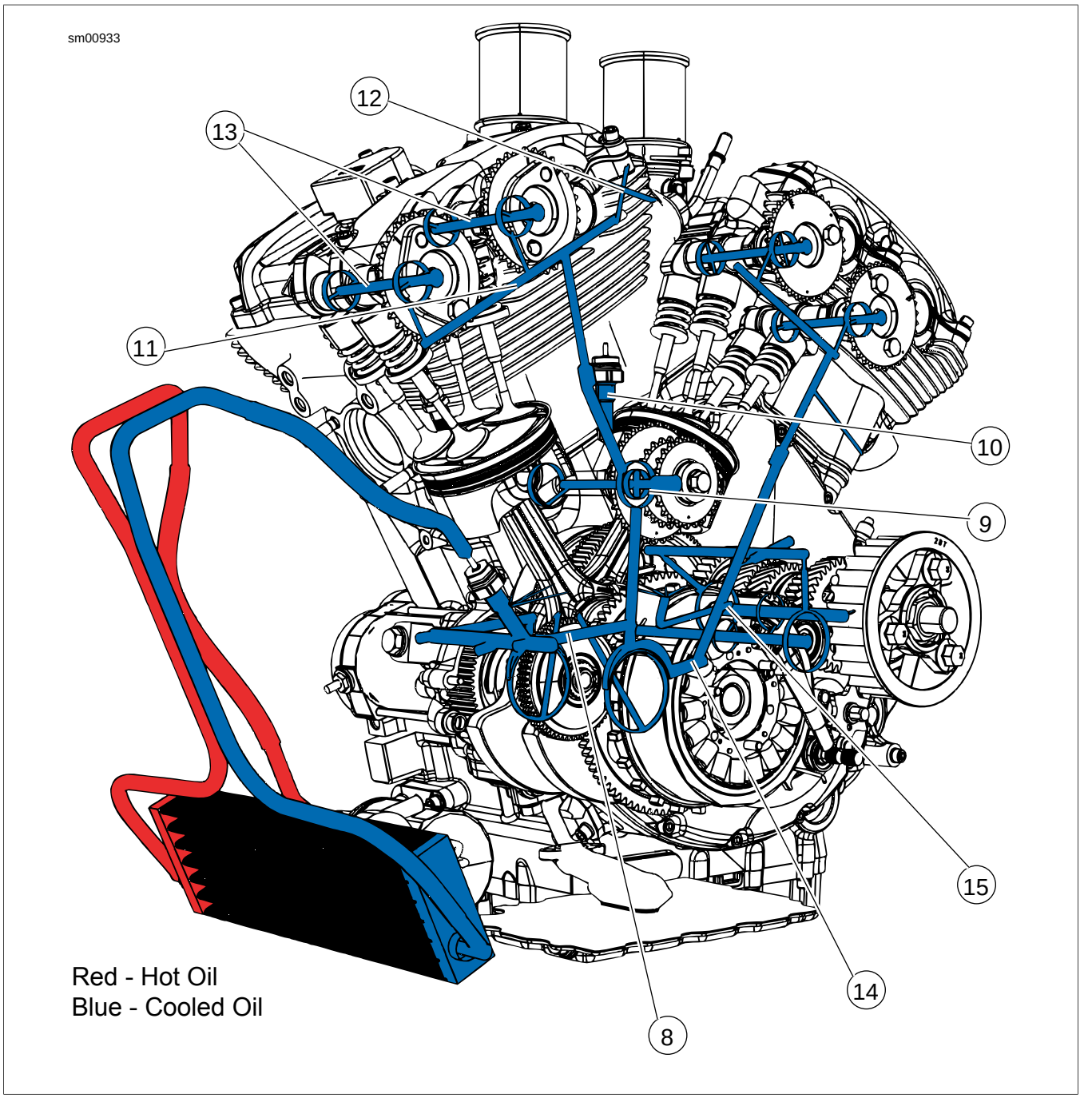


Figure 3-2. Oil Flow B

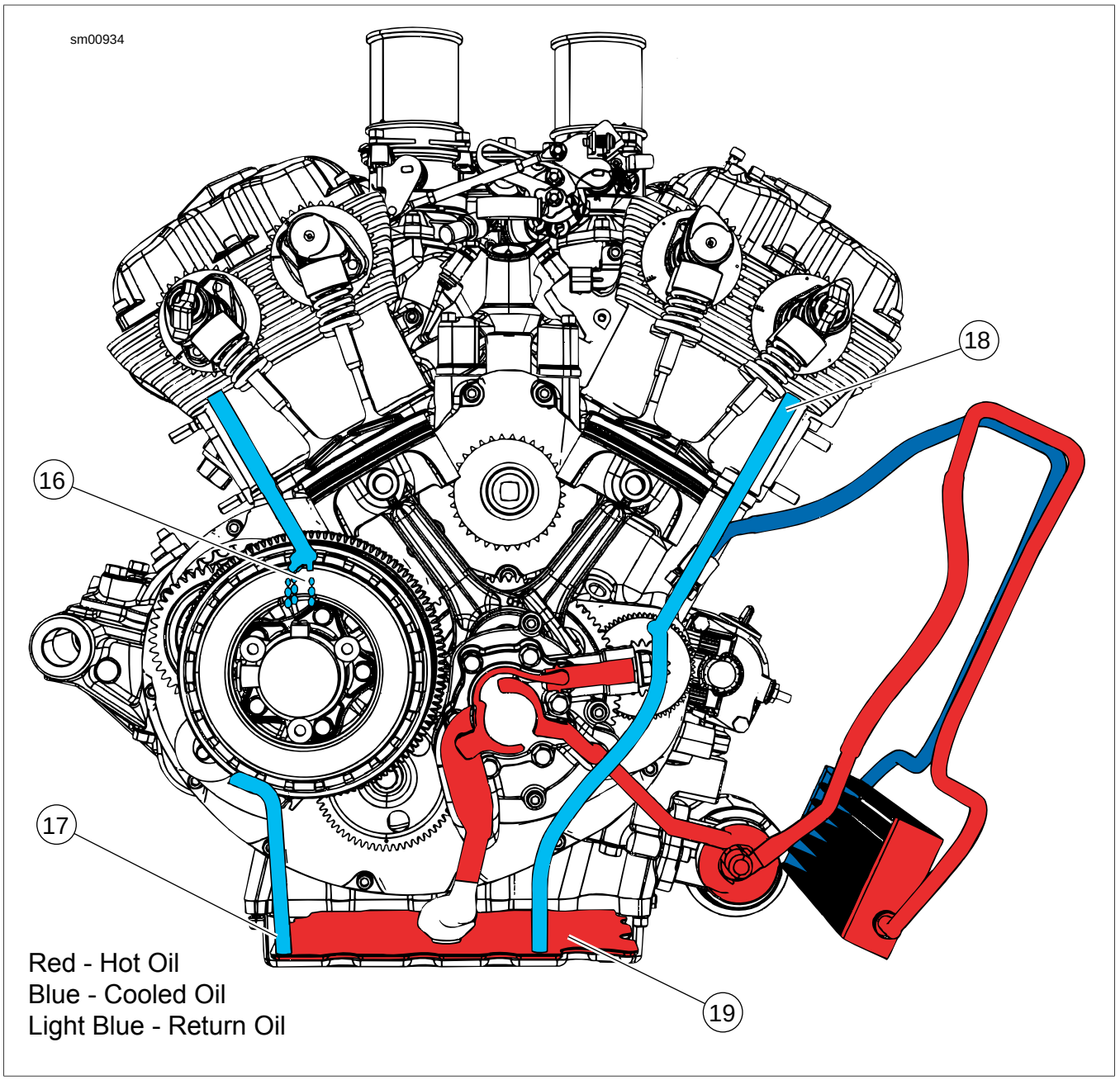


Figure 3-3. Oil Flow C

OIL PRESSURE 3.6

OIL PRESSURE INDICATOR LAMP

See Figure 3-4. The red oil pressure indicator lamp illuminates to indicate improper circulation of the engine oil. The lamp illuminates when the ignition is first turned on (before the engine is started), but should be extinguished once the engine is running.

NOTICE

If the oil pressure indicator lamp remains lit, always check the oil supply first. If the oil supply is normal and the lamp is still lit, stop the engine at once and do not ride further until the trouble is located and the necessary repairs are made. Failure to do so may result in engine damage. (00157a)

If the indicator lamp is not extinguished, it may be the result of a low oil level or diluted oil supply. A defect in the lamp wiring, faulty oil pressure sending unit, damaged oil pump, plugged oil filter element, incorrect oil viscosity, inoperative or weak spring in the oil pressure relief valve and/or damaged or incorrectly installed O-rings in the engine may also cause the indicator lamp to remain on.

To troubleshoot the problem, always check the engine oil level first. If the oil level is OK, check oil pressure.

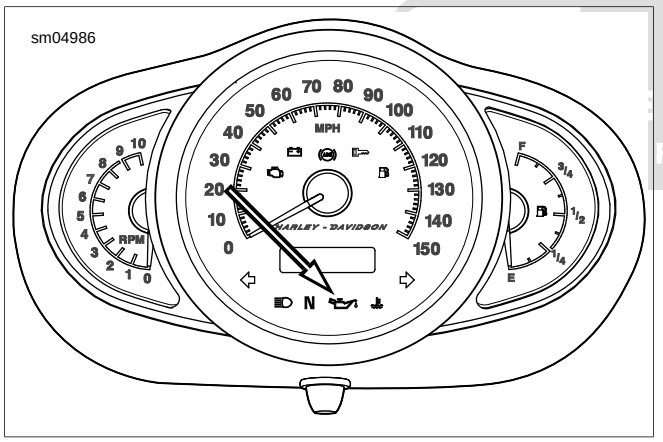


Figure 3-4. Oil Pressure Indicator Lamp (typical)

CHECKING OIL PRESSURE

PART NUMBER	TOOL NAME
HD-45308	OIL PRESSURE GAUGE
HD-45309	ADAPTER

Operating oil pressure is checked as follows:

1. Fill crankcase to proper level.

NOTE

Remove MAP sensor and horn for additional clearance if needed.

2. Remove oil pressure switch from crankcase.
3. Attach OIL PRESSURE GAUGE (Part No. HD-45308) to ADAPTER (Part No. HD-45309).
4. Install in oil pressure switch mounting hole.

NOTES

- *When checking oil pressure after engine rebuild, unplug fuel pump connector at fuel pump to verify oil pressure before engine starts.*
- *Engine oil should be at normal operating temperature 70 °C (158 °F) for an accurate reading.*

5. Oil pressure should be 296.5-648.1 kPa (43-94 psi) at 3000 RPM and normal operating temperature of 70 °C (158 °F).

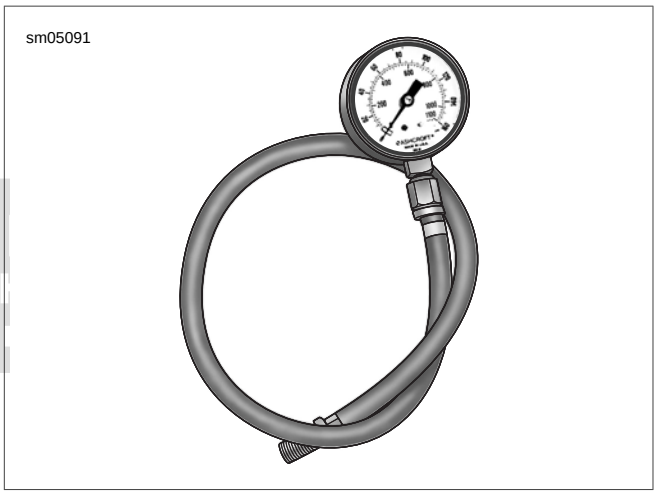


Figure 3-5. Oil Pressure Gauge

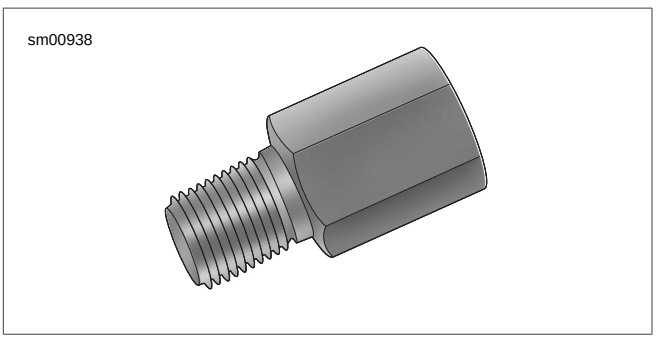


Figure 3-6. Oil Pressure Gauge Adapter

COMPRESSION TEST

PART NUMBER	TOOL NAME
HD-33223-1	CYLINDER COMPRESSION GAUGE

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1) that has a thread-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature when possible.

1. Remove air box, battery and spark plugs. See 1.7 AIR CLEANER AND EXHAUST SYSTEM, and 1.15 SPARK PLUGS AND COIL.
2. Connect compression tester to front cylinder per manufacturer's instructions.
3. Install battery. See 1.24 BATTERY MAINTENANCE.
4. Make sure transmission is in neutral. With throttle plates in wide open position, crank engine continuously through 5 to 7 full compression strokes.
5. Note gauge readings at the end of the first and last compression strokes. Record test results.
6. Repeat steps to test rear cylinder.
7. Review test results. Final compression reading should be at least 1379 kPa (200 psi) with no more than a ten percent variance between front and rear cylinders.
8. If compression of a cylinder does not fall within its upper and lower limits, refer to Table 3-21.

Table 3-21. Compression Test Results

TEST RESULTS	DIAGNOSIS
Compression low on first stroke, builds up on the following strokes, but does not reach normal. Improves considerably when oil is added to cylinder.	Ring trouble
Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Verify valve lash.	Valve trouble
Same results as valve trouble.	Head gasket leak

9. To verify worn piston rings, inject approximately 15 ml (1/2 oz) engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

DIAGNOSING VALVE TRAIN NOISE

PART NUMBER	TOOL NAME
HD-45334	SECONDARY CAM CHAIN MEASUREMENT TOOL

1. Visually inspect camshaft lobes for abnormal wear. See 1.20 VALVE LASH, Camshaft Inspection.
2. If there is noise and engine has low oil pressure, remove oil pan and inspect for metal debris.
3. On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, use SECONDARY CAM CHAIN MEASUREMENT TOOL (Part No. HD-45334) to check cam chain wear. See 1.21 SECONDARY CAM CHAIN.
4. Verify valve lash. See 1.20 VALVE LASH.

CYLINDER LEAKAGE TEST

PART NUMBER	TOOL NAME
HD-35667A	CYLINDER LEAKDOWN TESTER
HD-45314	CRANKSHAFT ROTATING WRENCH

The cylinder leakage test will pinpoint engine problems including leaking valves, worn, damaged or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume and measures the percent of leakage from the cylinder.

Use CYLINDER LEAKDOWN TESTER (Part No. HD-35667A) and 12 mm adapter and follow the instructions supplied with the tester.

1. Run engine to normal operating temperature.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove alternator inspection derby cover.
4. Remove air box cover, air filter top and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

5. Hold throttle wide open to observe the front cylinder intake valve through the intake port.
6. Turn crankshaft in direction of operation with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314). Open the valve fully, then continue until valve closes. When the intake valve has closed on the valve seat, turn the crank-

shaft an additional 3/8 turn (135 degrees). The front cylinder is now close to TDC.

7. To keep the crankshaft from turning over when air pressure is applied to the cylinder, engage transmission in fifth gear and lock the rear brake. Hold crankshaft with crankshaft rotating wrench if needed.

NOTE

Before performing the cylinder leakage test, verify that the tester itself is free from leakage to obtain the most accurate test results. Apply a soap solution around all tester fittings. Connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.

8. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent of leakage. Leakage greater than 15% indicates internal engine problems.
9. Listen for air leaks at throttle body, exhaust pipe, head gasket and crankcase breather. Air escaping through the throttle body indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

If air is escaping through valves, measure and adjust valve lash as required. See 1.20 VALVE LASH.

10. Repeat procedure on rear cylinder.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform 3.7 TROUBLESHOOTING, Compression Test or 3.7 TROUBLESHOOTING, Cylinder Leakage Test as described. If further testing is needed, remove suspect head(s) and inspect for the following:

NOTE

If engine is consuming oil, add engine oil dye and run engine prior to disassembly. This will help determine if porosity is present in the cylinder head or exhaust port cavity.

Check Prior to Cylinder Head Removal

1. Crankcase overfilled.
2. Oil carryover.
3. Breather hose restricted.
4. Restricted oil filter.

Check After Cylinder Head Removal

1. Valve guide seals.
2. Valve guide to valve stem clearance.
3. Gasket surface of both head and cylinder.
4. Cylinder head casting's porosity allowing oil to drain into combustion chamber.
5. Piston/ring failure.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

STRIPPING MOTORCYCLE FOR SERVICE 3.8

GENERAL

NOTE

If cylinder head, crankcase, or transmission work needs to be performed, engine must be removed from chassis.

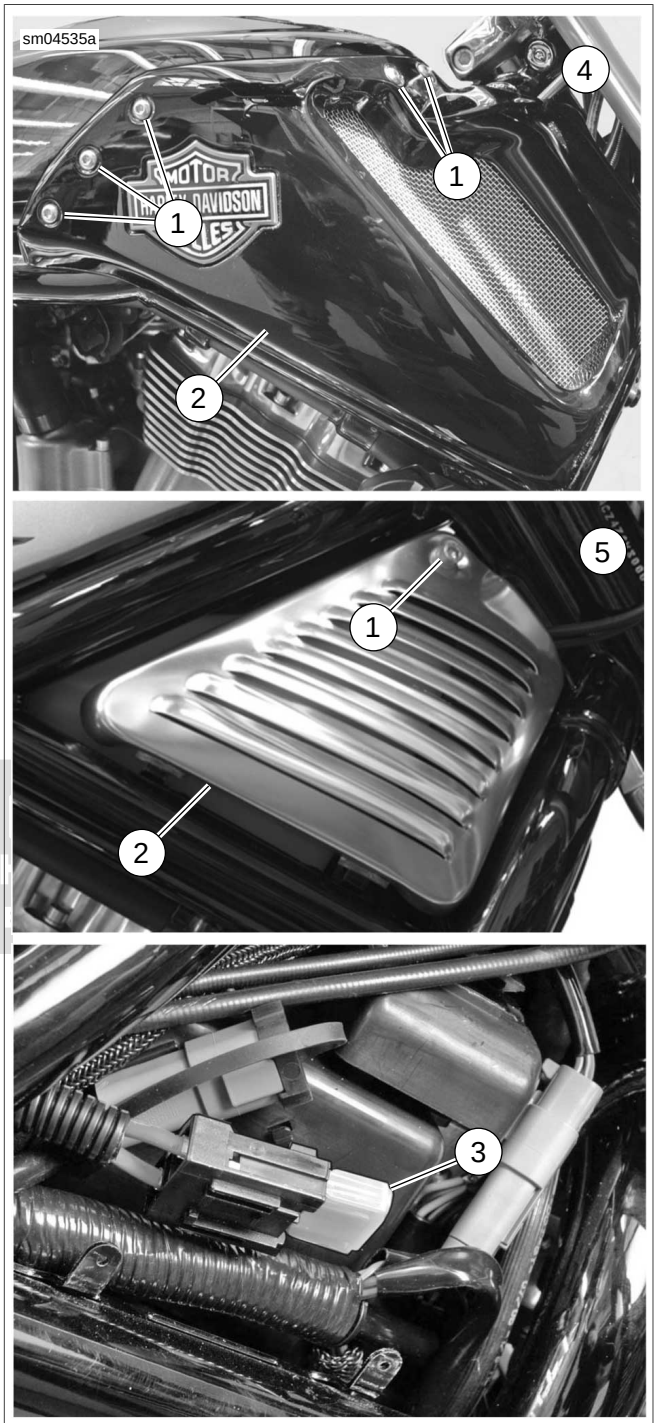
⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

Remove the engine. See 2.8 ENGINE REPLACEMENT.



1. Fastener
2. Side cover
3. Main fuse (40 amp)
4. VRSCF models
5. VRSCDX models

Figure 3-7. Main Fuse

ENGINE CRADLE AND STAND

PART NUMBER	TOOL NAME
HD-42310	ENGINE TRANSMISSION STAND
HD-42310-100	CRADLE LOCKING NUT AND SPACER
HD-42310-40	ENGINE CRADLE
HD-43646-A	ROLLING ENGINE STAND

Prior to engine service, all fluids should be drained from the engine and the engine removed from the chassis.

To support the engine, use ENGINE CRADLE (Part No. HD-42310-40) mounted to ENGINE TRANSMISSION STAND (Part No. HD-42310) for bench work or to ROLLING ENGINE STAND (Part No. HD-43646-A) for floor work.

The engine cradle is bolted to threaded holes in the front and rear of the upper engine case.

1. See Figure 3-8. Using fasteners provided, install ENGINE CRADLE to rear of upper engine case.
2. Install fasteners at front of engine.
3. With engine securely strapped, hoist engine and cradle to ENGINE/TRANSMISSION STAND and slide cradle shaft into post of stand.
4. See Figure 3-9. If mounting to ROLLING ENGINE STAND, slide spacer ring from CRADLE LOCKING NUT AND SPACER (Part No. HD-42310-100) on cradle shaft before mounting to stand.

NOTE

The spacer ring is used only when securing the cradle to the ROLLING ENGINE STAND (Part No. HD-43646-A).

5. Rotate engine and cradle to align holes in cradle shaft to holes in stand post and secure with locking pin.
6. See Figure 3-10. Install fastener and handle from CRADLE LOCKING NUT AND SPACER RING (Part No. HD-42310-100).
7. To access engine components from different angles, remove locking pin, rotate cradle and engine, align holes closest to desired angle and insert locking pin to secure.

NOTE

Dirt caked on fins and other areas can fall into crankcase bore or stick to subassemblies as parts are removed. Abrasive particles can damage machined surfaces or plug oil passage-ways. Remove all dirt and particles before disassembly to prevent component damage.

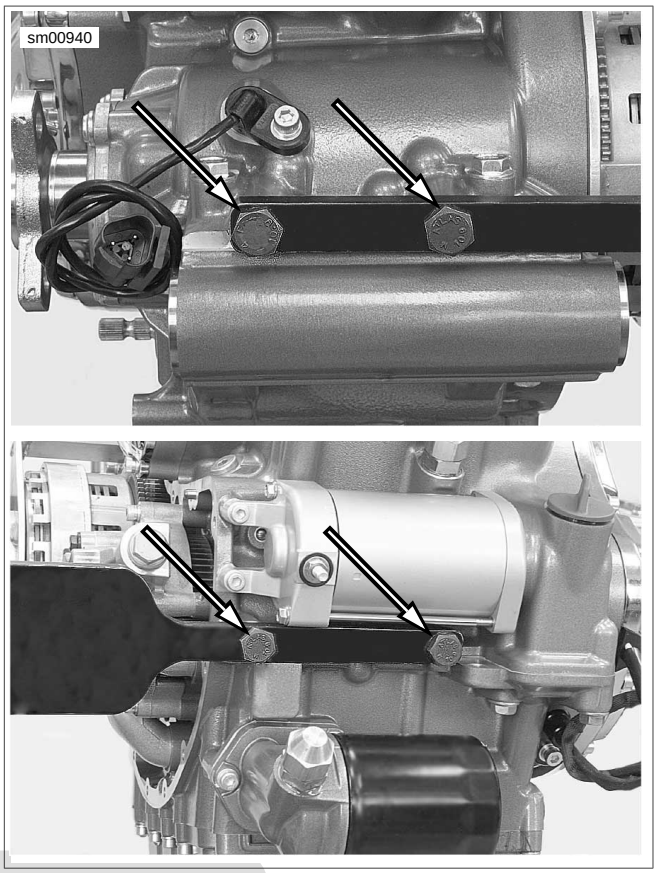


Figure 3-8. Cradle Fasteners in Upper Engine Case

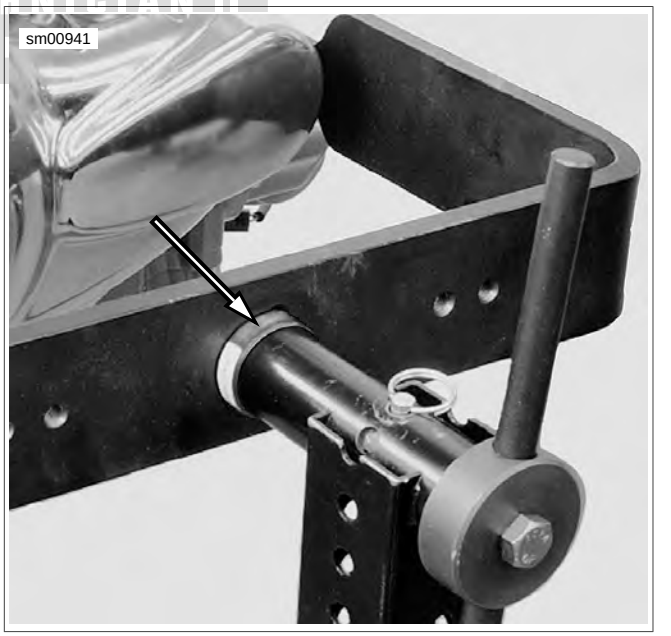


Figure 3-9. Spacer Ring

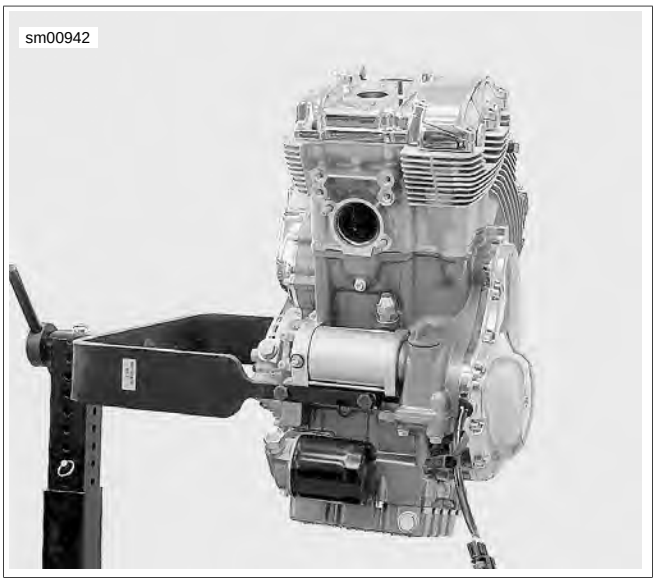


Figure 3-10. Engine in Cradle and Rolling Stand

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING 3.9

CAMSHAFT AND SECONDARY TIMING CHAIN REMOVAL

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45315	ALTERNATOR ROTOR REMOVER
HD-45491	TAPPET COMPRESSING TOOL
HD-45653	TDC POSITIONING TOOL

1. Remove clutch cover and oil pump assembly.
2. Remove alternator derby cover. See 7.19 ALTERNATOR.
3. Remove ignition coils and spark plugs. See 1.15 SPARK PLUGS AND COIL.
4. See Figure 3-12. Remove cam cover fasteners in reverse order of torque sequence and remove cam covers.
5. See Figure 3-13. Install TDC POSITIONING TOOL (Part No. HD-45653) in front spark plug hole.

NOTE

Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

6. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314), rotate the crankshaft counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and crankshaft is approaching TDC.
7. When the TDC positioning tool is fully extended, verify cam timing. See 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing.

NOTE

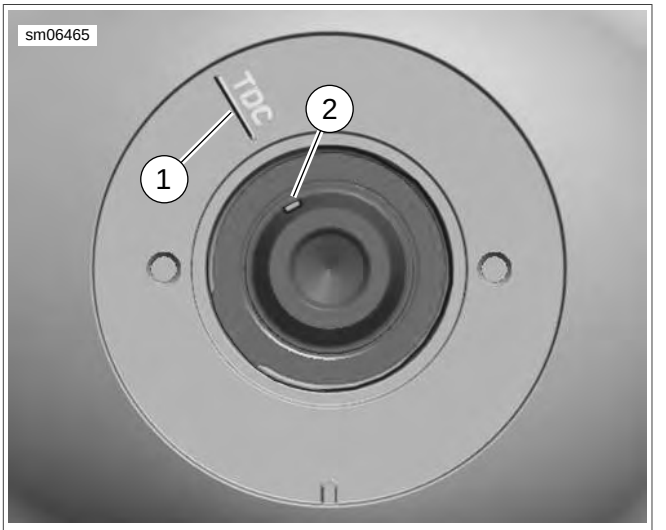
See Figure 3-11. The alternator cover has a TDC timing mark. Number 1 piston is at top dead center when crankshaft keyway is aligned with TDC mark. To avoid removal of the alternator bolt, mark the head of the bolt at TDC. If alternator cover is removed or TDC mark is not visible, complete remainder of procedure utilizing the TDC POSITIONING TOOL (Part No. HD-45653).

8. With cam timing verified and the TDC positioning tool showing exact TDC on the front cylinder:
 a. Clean surface of alternator bolt with solvent and a shop towel.
 b. Use a paint pen and mark on alternator bolt an alignment mark with the TDC mark on alternator cover.

NOTE

If alternator bolt is being removed for a complete engine disassembly, repeat this procedure upon final assembly.

9. Remove TDC positioning tool.



1. **TDC marking on cover**
2. **Crankshaft keyway**

Figure 3-11. TDC Timing Alignment (alternator bolt removed)

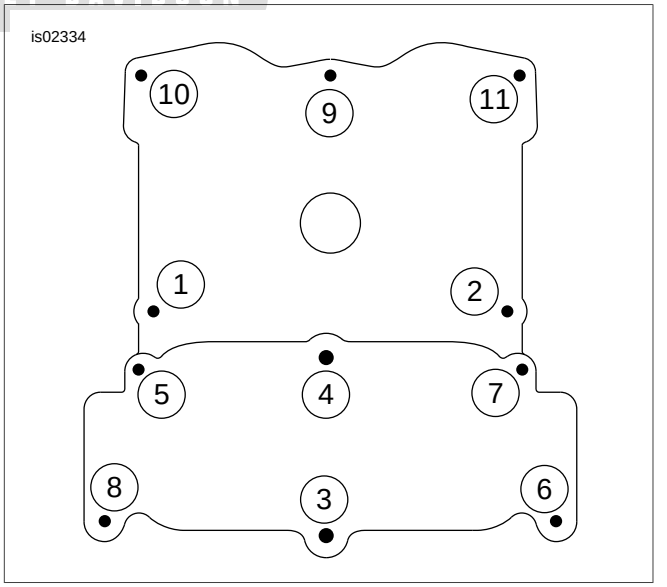


Figure 3-12. Cam Cover Torque Sequence

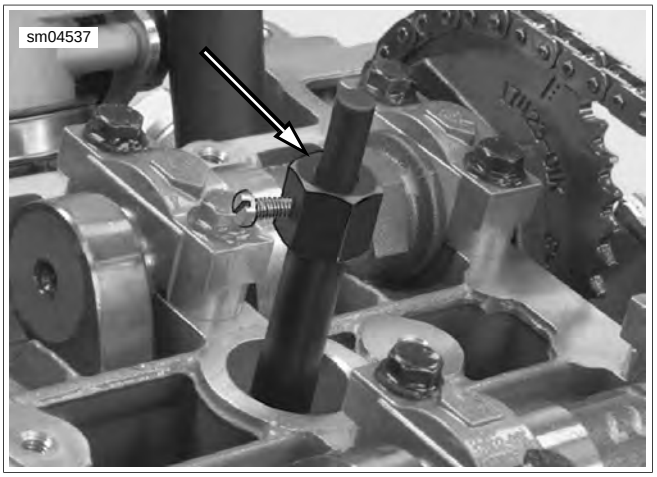


Figure 3-13. Top Dead Center Positioning Tool

10. See Figure 3-14. Hold 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH and loosen alternator bolt. Air impact tool may be used for REMOVAL ONLY.
11. See Figure 3-15. Hold 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH and loosen starter limiter fastener.
12. See Figure 3-16. Loosen triple sprocket fastener.
13. See Figure 3-17. Install ALTERNATOR ROTOR REMOVER (Part No. HD-45315) and finger tighten.
14. Use an impact socket and wrench to tighten the tool to remove the rotor and the ball clutch from the crankshaft taper. Use a light duty air impact wrench if necessary.

NOTE

Do not drop the rotor shell during removal process.

15. See Figure 3-15. Remove starter limiter fastener and starter limiter gear assembly.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

16. See Figure 3-18. Remove snap ring from crankshaft.

NOTE

Do not disassemble the starter limiter assembly. Do not remove snap ring from limiter assembly.

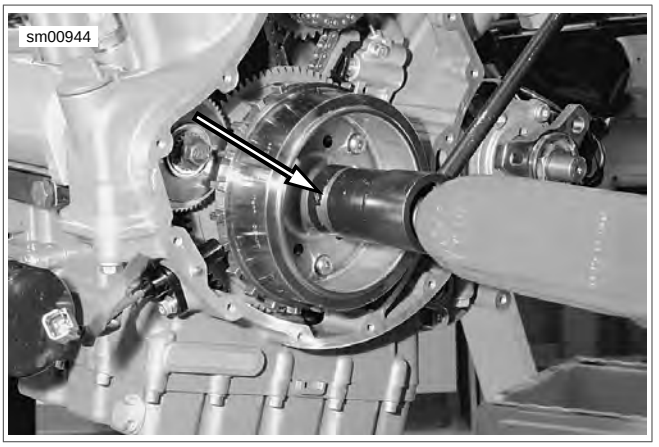


Figure 3-14. Rotor Fastener

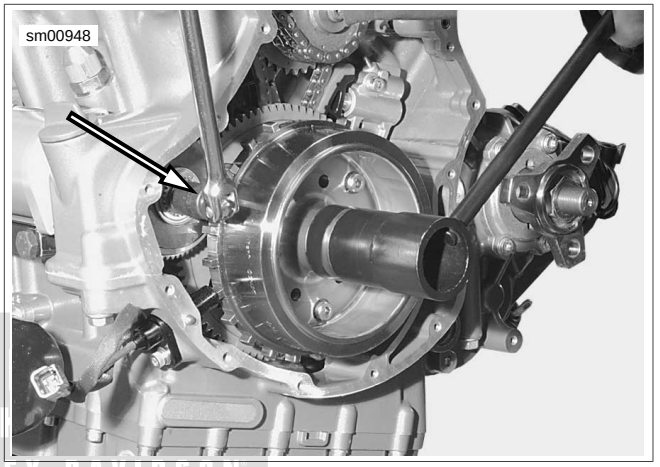


Figure 3-15. Starter Limiter Fastener

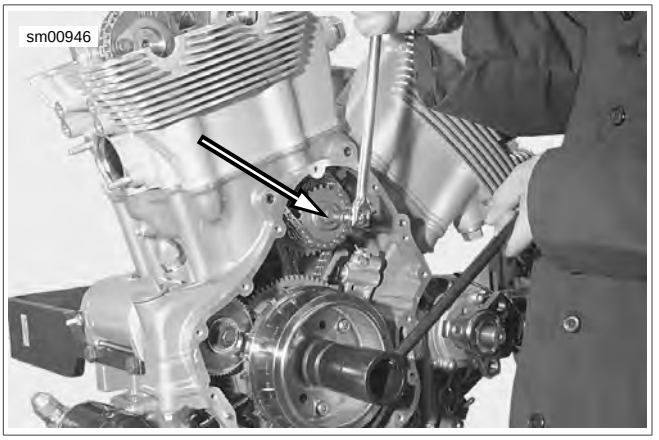


Figure 3-16. Triple Sprocket Fastener

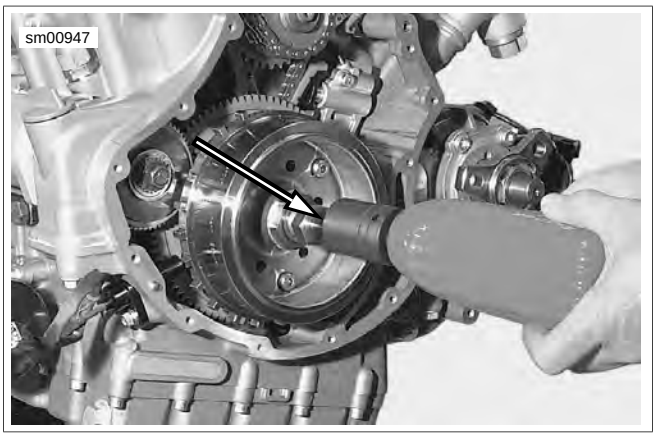


Figure 3-17. Rotor Shell

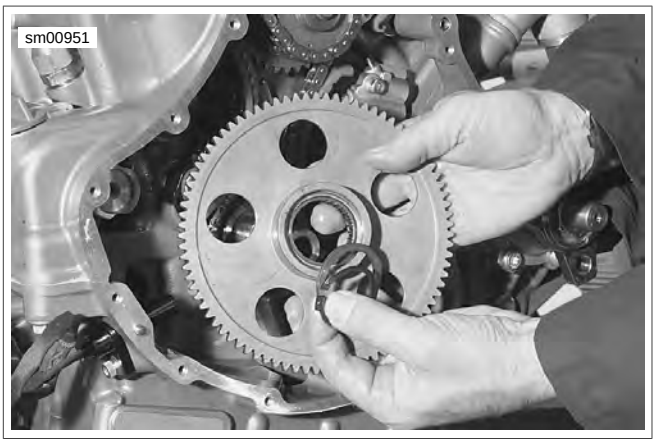


Figure 3-19. Snap Ring and Ball Clutch Gear

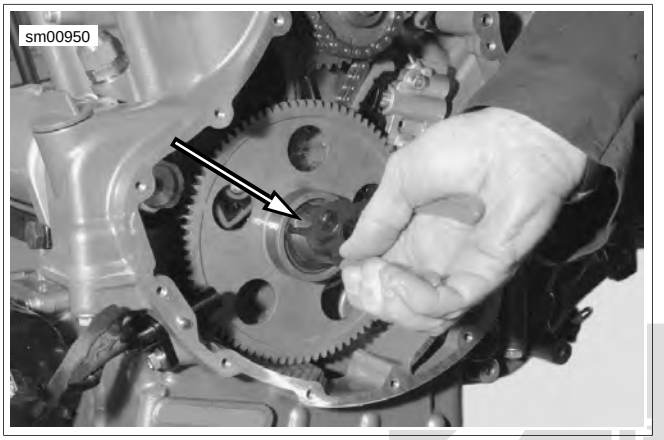


Figure 3-18. Snap Ring

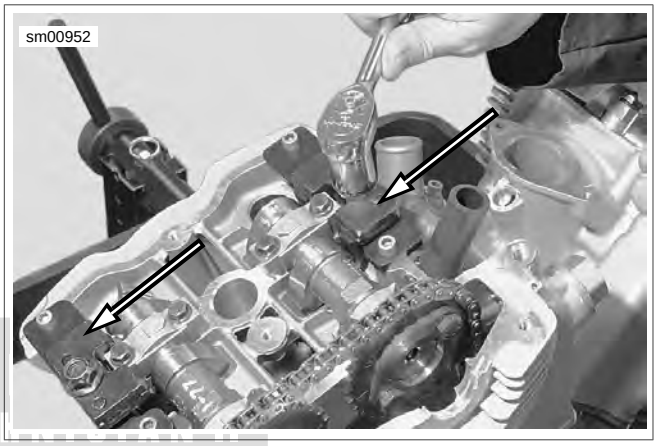


Figure 3-20. Tappet Compressing Tools (typical)

17. See Figure 3-19. Slide snap ring, washer, and ball clutch gear with needle roller and cage assembly off of crankshaft.

NOTES

- *If the crankshaft rotates slightly, be sure to re-locate front piston TDC.*
- *For the following procedure, the front cylinder cams are pre-loaded.*

18. See Figure 3-20. Install TAPPET COMPRESSING TOOL (Part No. HD-45491) on front cylinder to aid in disassembly.
 a. Loosen 19 mm nut on tappet compressing tool.
 b. Tools are marked intake and exhaust. Position them accordingly.
 c. Tighten 19 mm nut to compress tappets.

19. See Figure 3-21. Remove secondary cam chain tensioner.

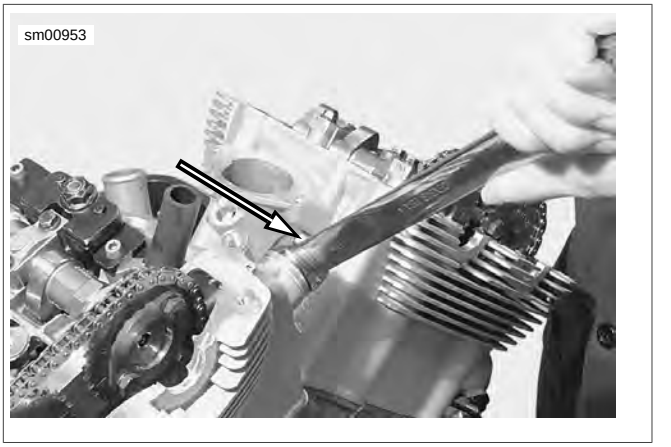


Figure 3-21. Remove Secondary Cam Chain Tensioner (typical)

NOTES

- *Mark or tag chains, front and rear, to match the chains to the front intake and exhaust cam or the rear intake and*

exhaust cam. The chains are installed with the brass links outboard or on the alternator side.

- *See Figure 3-22. The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets.*
- *See Figure 3-23. The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets.*
- *Do not attempt to remove camshaft journal caps without first relieving valve spring pressure using tappet compressing tool on front cylinder.*

20. Remove cam journal caps.
21. See Figure 3-24. Roll chain over cam drive gear. Lift cam and drive gear from head.
22. In this position the rear cams are not preloaded. Remove rear cylinder journal caps. Disconnect cams from chain.
23. Remove chains.
24. Inspect camshafts. See 1.20 VALVE LASH, Camshaft Inspection.

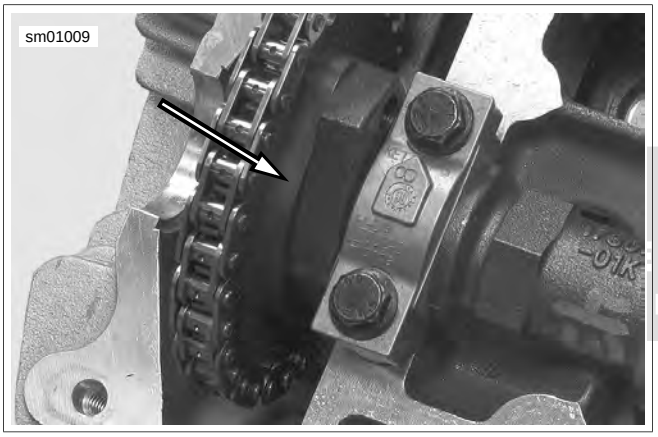
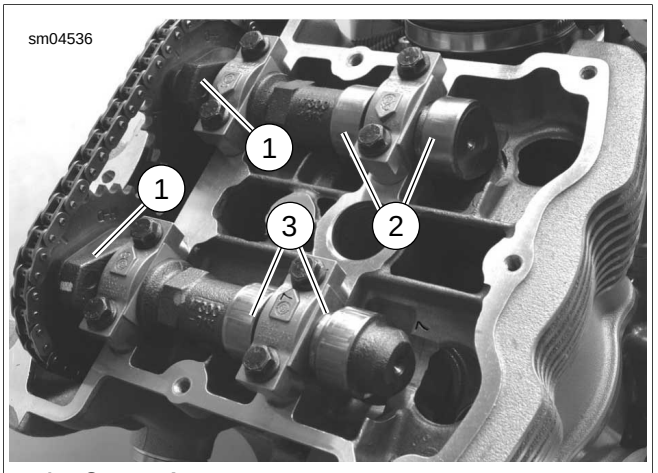


Figure 3-22. Spacer Boss on Inside (rear cylinder cam sprocket)



1. **Spacer boss**
2. **Intake cam lobes**
3. **Exhaust cam lobes**

Figure 3-23. Rear Cylinder Cams

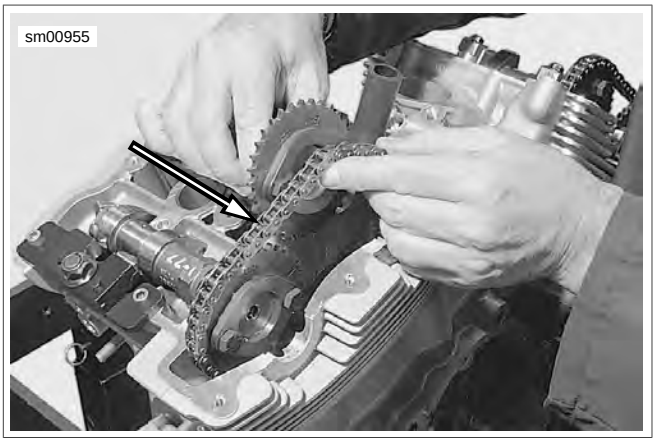


Figure 3-24. Cam Drive Chain (typical)

PRIMARY CAM DRIVE REMOVAL

PART NUMBER	TOOL NAME
HD-43526	PRIMARY CHAIN TENSIONER RETAINER

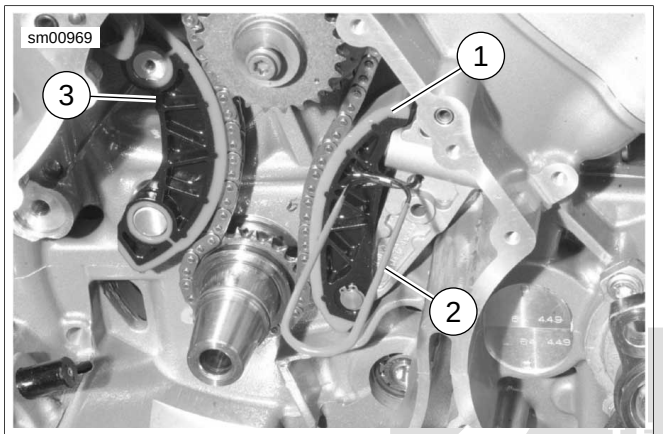
1. Remove rotor shell and starter limiter gear. See 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal.
2. Remove water pump fasteners and cover.
3. See Figure 3-25. Remove water pump housing. Using a soft face hammer, GENTLY tap around edge of housing while exerting outward pressure.
4. Hold crankshaft at TDC and remove the triple sprocket fastener.
5. See Figure 3-26. Retract primary cam chain tensioner (1) and insert PRIMARY CHAIN TENSIONER RETAINER (Part No. HD-43526) (2). Remove primary cam chain tensioner.
6. Remove primary cam chain fixed guide (3).
7. See Figure 3-27. Push triple sprocket/water pump shaft through engine toward the clutch side.
8. Remove triple sprocket and primary cam chain.

NOTES

- *For installation procedure, proceed to 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation.*
- *If doing a complete engine overhaul, proceed to 3.10 CYLINDER HEAD and follow steps in 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal.*



Figure 3-25. Removing Water Pump Housing



1. **Primary chain tensioner**
2. **Retainer**
3. **Primary chain fixed guide**

Figure 3-26. Primary Chain Tensioner Retainer

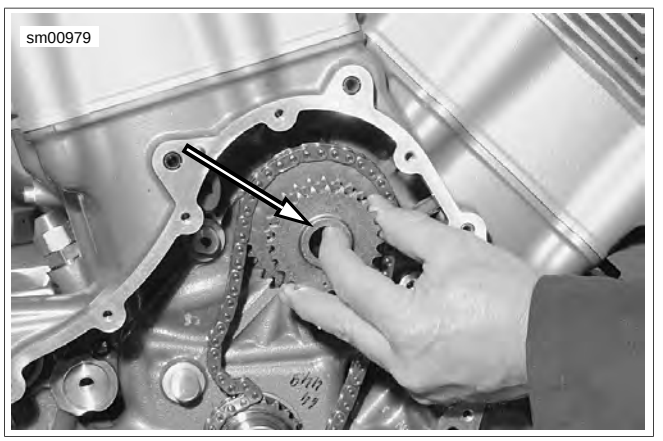


Figure 3-27. Triple Sprocket/Water Pump Shaft

PRIMARY CAM DRIVE INSTALLATION

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45326	PRIMARY CAM CHAIN TENSIONER RETAINER
HD-45653	TDC POSITIONING TOOL

FASTENER	TORQUE VALUE	
Primary chain hydraulic tensioner fasteners	9.7 Nm	86 **in-lbs**
Triple sprocket fastener	23 Nm	17 ft-lbs
Primary chain fixed tensioner fastener	9.7 Nm	86 **in-lbs**
Starter limiter assembly fastener	46 Nm	34 ft-lbs
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs

1. See Figure 3-28. Install TDC POSITIONING TOOL (Part No. HD-45653) in front spark plug hole. Rotate the front cylinder piston to TDC. Do not allow crankshaft to rotate until assembly is complete.
2. See Figure 3-29. Insert water pump shaft through case until flush with case on cam drive side.
3. See Figure 3-30. Align timing dot on triple sprocket with the one on the case and position on water pump shaft with drive chain on crankshaft drive gear. Squeeze drive chain to simulate the chain tensioners in place and verify dot alignment. Walk chain around crankshaft gear to change position if necessary.
4. See Figure 3-31. Install primary chain fixed tensioner. Note the flat in the chain tensioner bore and the flat on the mounting shaft in the case.

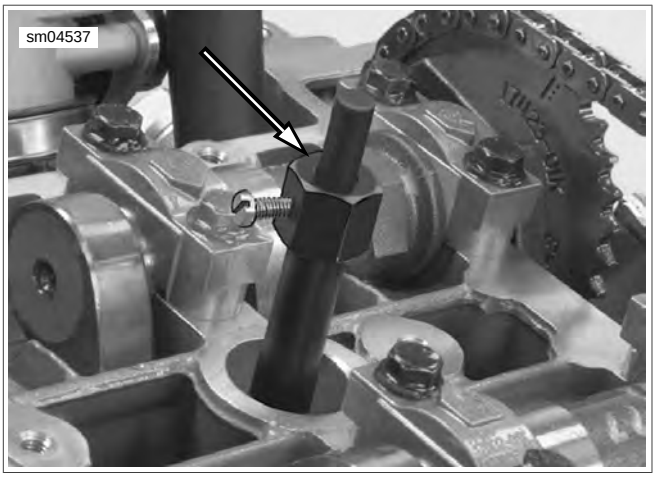


Figure 3-28. Top Dead Center Positioning Tool

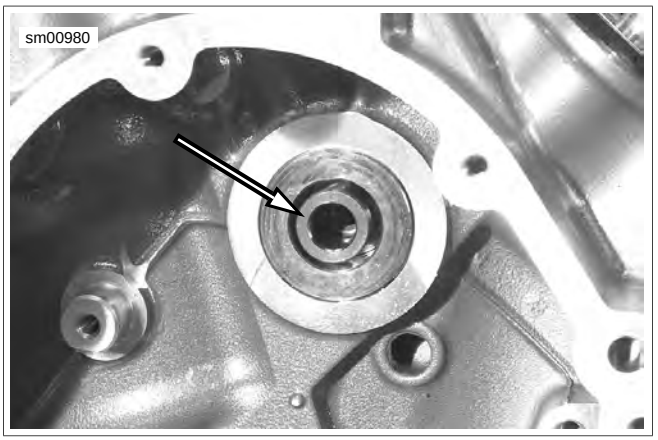


Figure 3-29. Water Pump Shaft

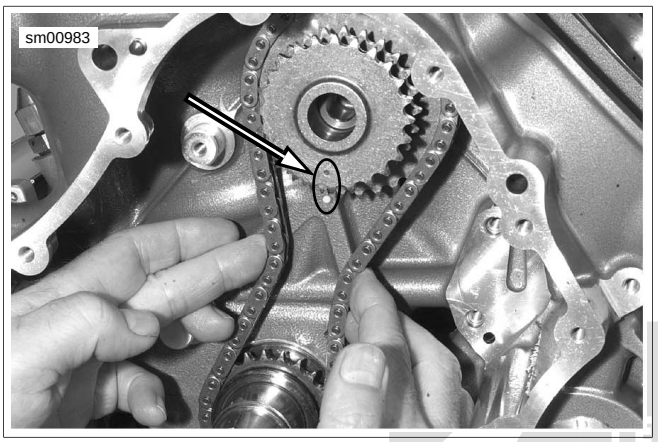


Figure 3-30. Triple Sprocket Timing Marks

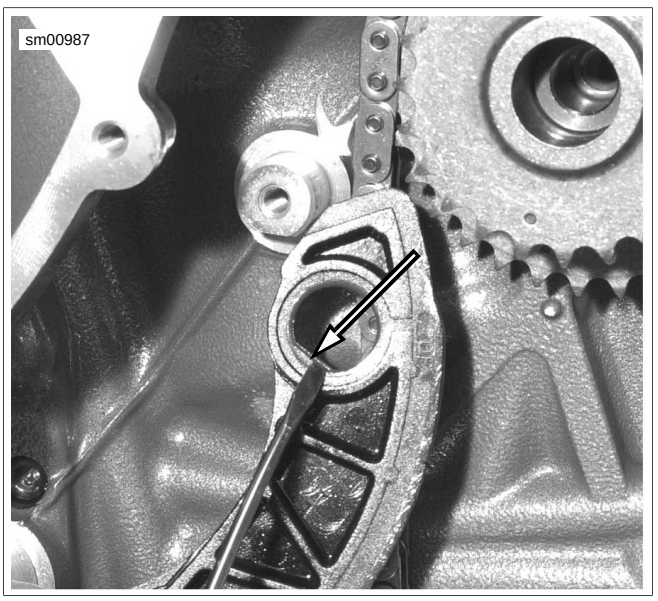


Figure 3-31. Primary Chain Fixed Tensioner

5. Guide the chain over the edge of the primary cam chain fixed tensioner.
6. See Figure 3-32. Retract the chain tensioner and install PRIMARY CAM CHAIN TENSIONER RETAINER (Part No. HD-45326).
7. Verify crankshaft is still at TDC and confirm the position of the timing marks.
8. See Figure 3-33. Install primary chain hydraulic tensioner fastener. Tighten to 9.7 Nm (86 **in-lbs**).
9. See Figure 3-34. Install triple sprocket fastener. Hold crankshaft from clutch side and tighten to 23 Nm (17 ft-lbs).
10. See Figure 3-35. Install fastener on primary chain fixed tensioner. Tighten to 9.7 Nm (86 **in-lbs**).
11. See Figure 3-36. Install needle roller bearing, ball clutch gear, and thrust washer on crankshaft.

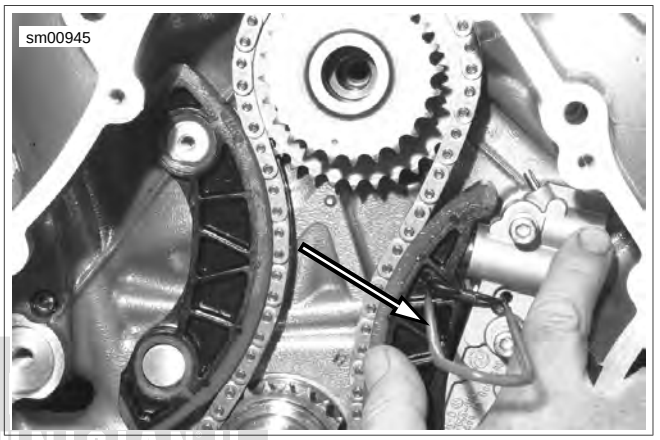


Figure 3-32. Primary Chain Tensioner Retainer

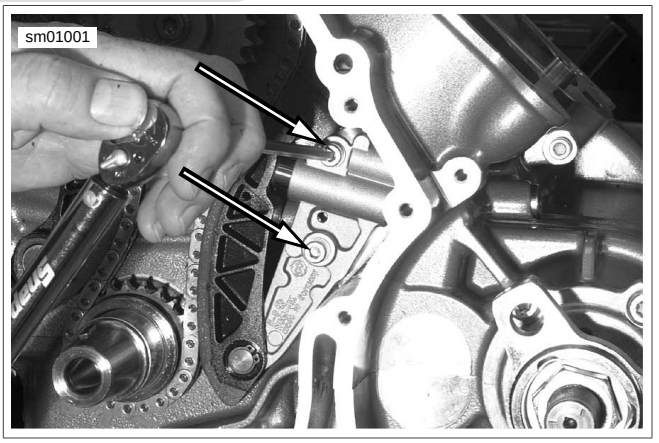


Figure 3-33. Primary Chain Hydraulic Tensioner

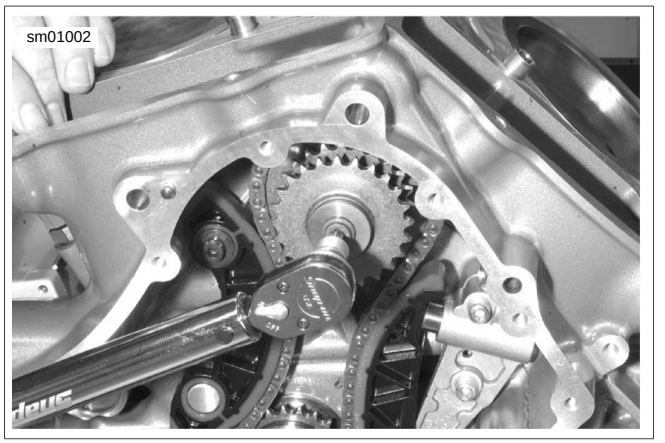


Figure 3-34. Triple Sprocket

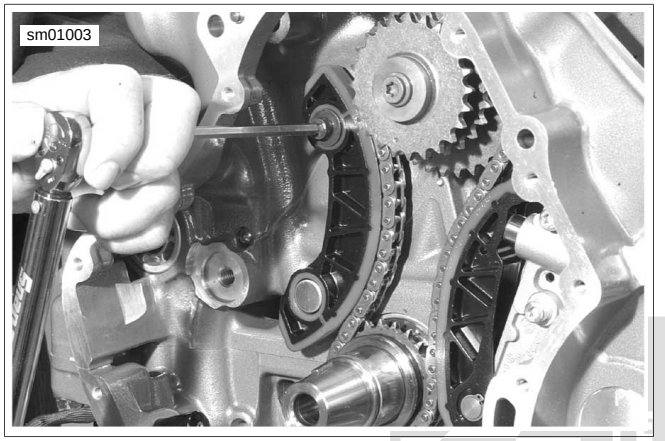


Figure 3-35. Primary Chain Fixed Tensioner

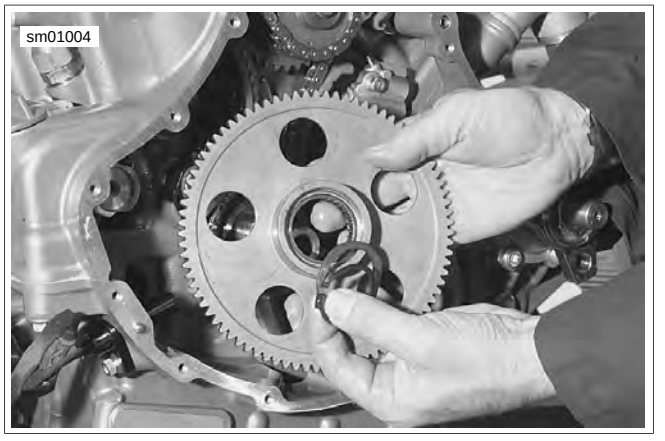


Figure 3-36. Needle Roller Bearing, Ball Clutch Gear, Thrust Washer and Retaining Ring

12. See Figure 3-37. Snap the retaining ring into place.



Figure 3-37. Retaining Ring

13. See Figure 3-38. Install starter limiter gear assembly and starter limiter fastener. Tighten fastener to 46 Nm (34 ft-lbs).

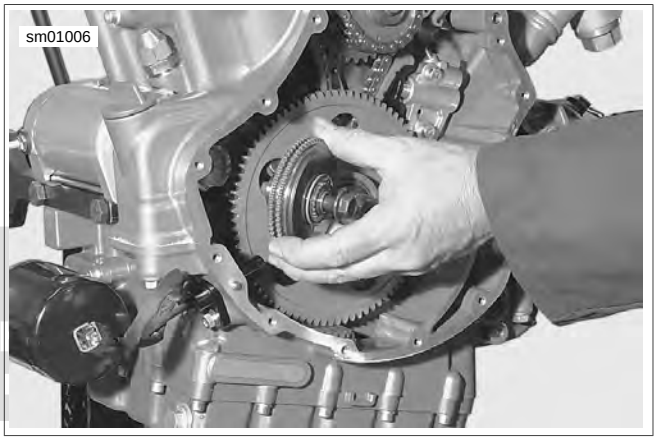


Figure 3-38. Starter Limiter Gear and Fastener

NOTE

Check that woodruff key is in place during assembly.

14. Install rotor shell with the integral ball clutch.
15. See Figure 3-39. Hold the rotor with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) and tighten rotor bolt to 83 Nm (61 ft-lbs) then loosen one full turn.
16. Final tighten to 180 Nm (132 ft-lbs).

NOTE

To continue engine overhaul, see 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing.

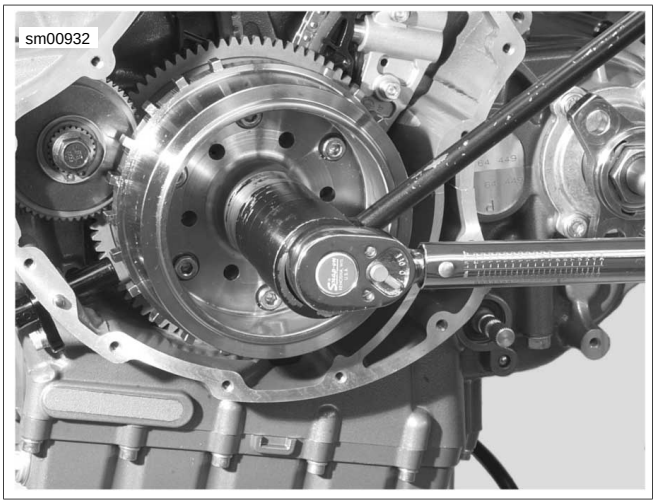


Figure 3-39. Install Rotor Shell

INSTALLATION OF CAMS, TIMING CHAINS AND CAMSHAFT TIMING

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45316	CRANKSHAFT ASSEMBLY RETAINER
HD-45340	GASKET ALIGNMENT DOWELS
HD-45491	TAPPET COMPRESSING TOOL
HD-45653	TDC POSITIONING TOOL

FASTENER	TORQUE VALUE	
Camshaft sprocket fasteners	23 Nm	17 ft-lbs
Cam journal caps	9.7 Nm	86 **in-lbs**
Cam chain tensioner, secondary	100 Nm	74 ft-lbs
Cam journal caps	9.7 Nm	86 **in-lbs**
Cam chain tensioner, secondary	100 Nm	74 ft-lbs
Spark plugs	23 Nm	17 ft-lbs
Cam cover fasteners	11 Nm	97 **in-lbs**

1. See Figure 3-40. Using the TDC POSITIONING TOOL (Part No. HD-45653) in front cylinder spark plug hole, verify the crankshaft is at front cylinder TDC.

NOTES

- *Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.*
- *If camshafts have been replaced, verify camshaft sprocket fasteners are tightened to 23 Nm (17 ft-lbs).*

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

2. If necessary, use CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) to rotate the engine counterclockwise (direction of operation) to locate front piston TDC.
3. If removed, record shim thickness for reference and install all eight shims in their original location. Use a low-strength magnet to position the shim and push into place.
4. Install tappets in their original locations.

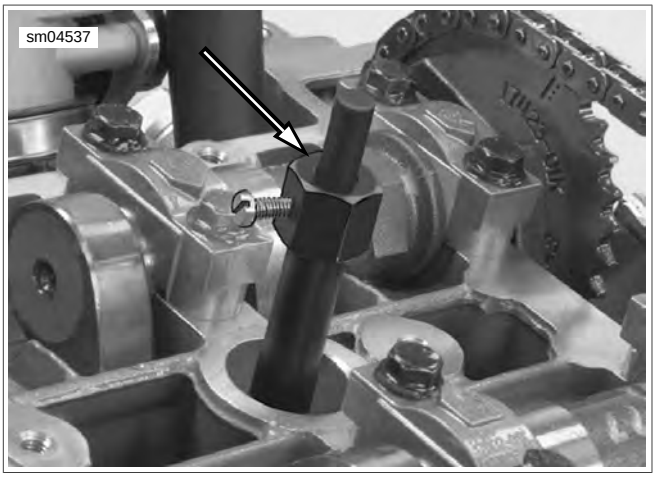


Figure 3-40. Top Dead Center Positioning Tool

NOTES

- *See Figure 3-41. Match front cam chain to front cylinder cams and rear cylinder chain to rear cylinder cams by marks or tags placed during disassembly. The chains are installed with the copper links outboard or on the alternator side. See 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING.*
- *See Figure 3-42. The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets.*
- *See Figure 3-43. The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets.*

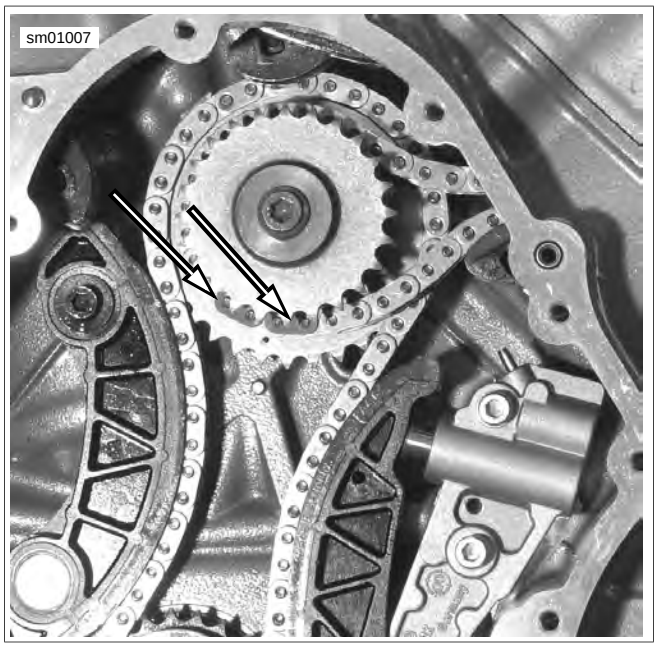


Figure 3-41. Copper Timing Links

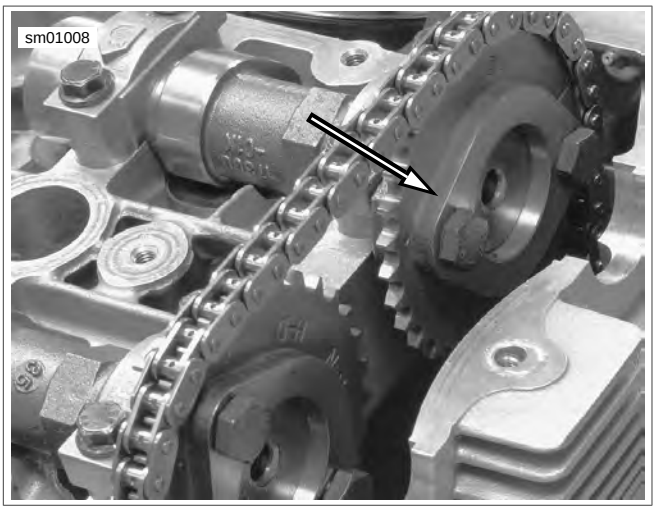


Figure 3-42. Spacer Boss on Outside (front cylinder cam sprocket)

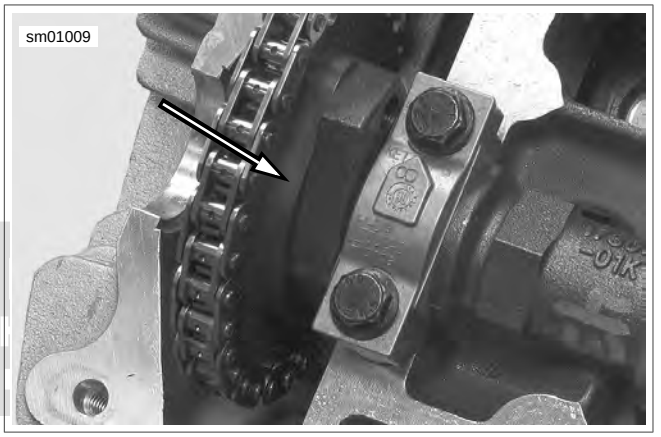
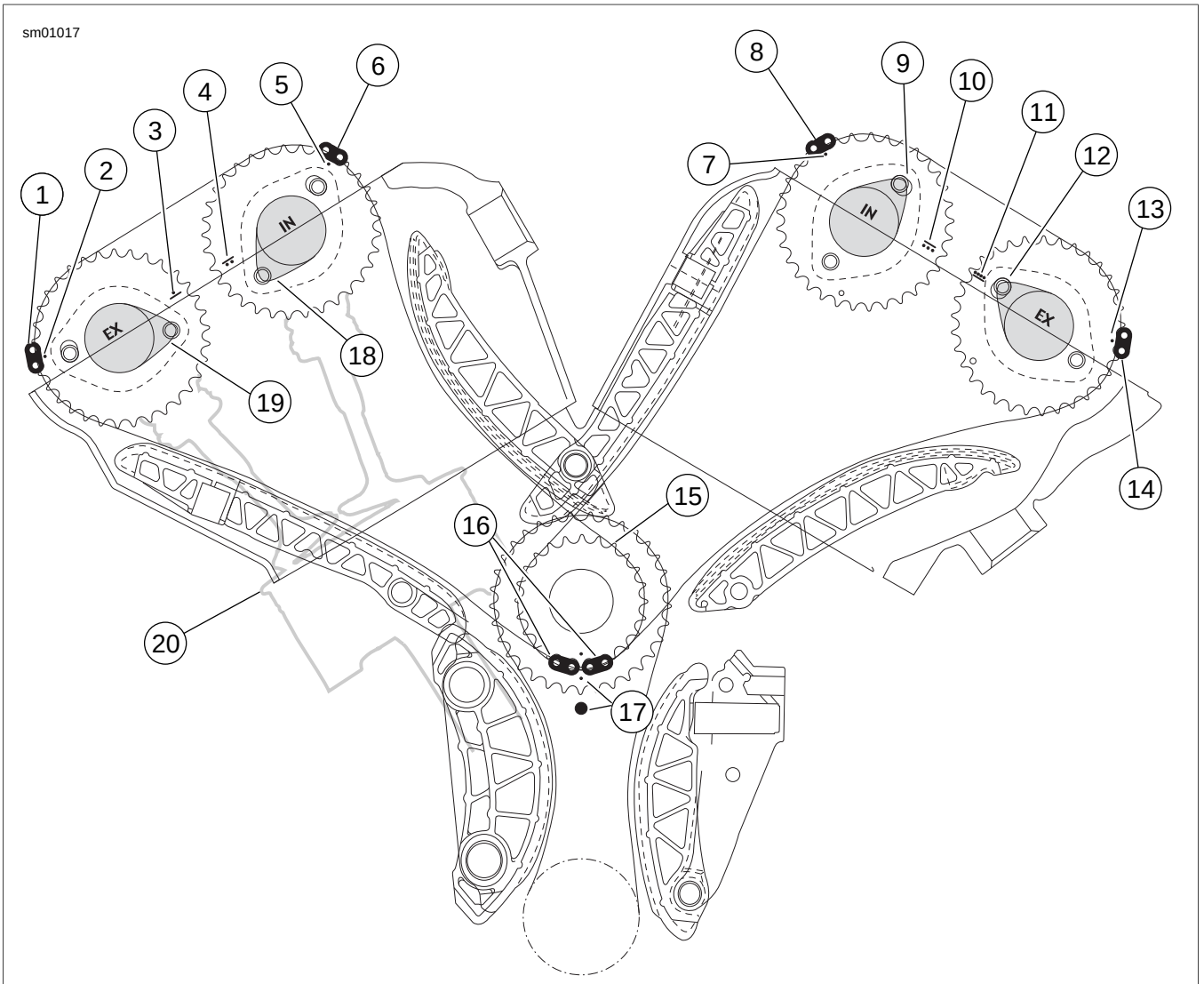


Figure 3-43. Spacer Boss on Inside (rear cylinder cam sprocket)



1. **Front exhaust copper link**
2. **Front exhaust EX timing dot**
3. **Front exhaust alignment mark (single dot and line)**
4. **Front intake alignment mark (two dots and line)**
5. **Front intake IN timing dot**
6. **Front intake copper link**
7. **Rear intake IN timing dot**
8. **Rear intake copper link**
9. **Rear intake cam lobe position**
10. **Rear intake alignment mark (three dots and line)**
11. **Rear exhaust alignment mark (four dots and line)**
12. **Rear exhaust cam lobe position**
13. **Rear exhaust EX timing dot**
14. **Rear exhaust copper link**
15. **Triple sprocket**
16. **Twin cam drive chain copper links**
17. **Triple sprocket to crankcases alignment marks**
18. **Front intake cam lobe position**
19. **Front exhaust cam lobe position**
20. **Front piston at TDC**

Figure 3-44. Cam Drive Timing Marks (secondary cam chain tensioners are not shown)

NOTE

Crankshaft must be at front cylinder TDC with TDC POSITIONING TOOL (Part No. HD-45653) in place.

5. See Figure 3-44. Insert rear cylinder cam drive chain down from the rear head. Wrap chain around middle row of triple sprocket teeth with the copper chain links (16) straddling the triple gear timing mark.
6. See Figure 3-45. Lubricate cam journals, lobes, and tappets with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, apply a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE.



Figure 3-45. Lubricate Cam

7. See Figure 3-44. Insert rear exhaust cam into cylinder head and align copper link (14) straddling the single dot timing mark labeled as EX (13).
8. Insert rear intake cam into cylinder head and align copper link (8) straddling the single dot timing mark labeled IN (7).
9. See Figure 3-44. Verify that:
 a. The single copper link (8) on the cam drive chain straddles the IN single dot (7) on the intake cam sprocket.
 b. The single copper link (14) on the cam drive chain straddles the EX single dot (13) on the exhaust cam sprocket.
 c. The three dot timing line (10) on the intake cam sprocket is aligned with the four dot timing line (11) on the exhaust cam sprocket.
 d. The rear intake and exhaust cam lobes (9, 12) are positioned as illustrated.

NOTES

- *Finger-tighten cam journal caps before applying torque.*
- *If not on base circle, do not attempt to install journal caps without first relieving valve spring pressure using tappet compressing tool. Failure to follow this procedure will result in damage to cylinder head.*

10. See Figure 3-46. Lubricate cam journal caps and fasteners.
11. See Figure 3-47. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head.
12. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
13. See Figure 3-48. Install rear cylinder secondary cam chain tensioner and tighten to 100 Nm (74 ft-lbs).

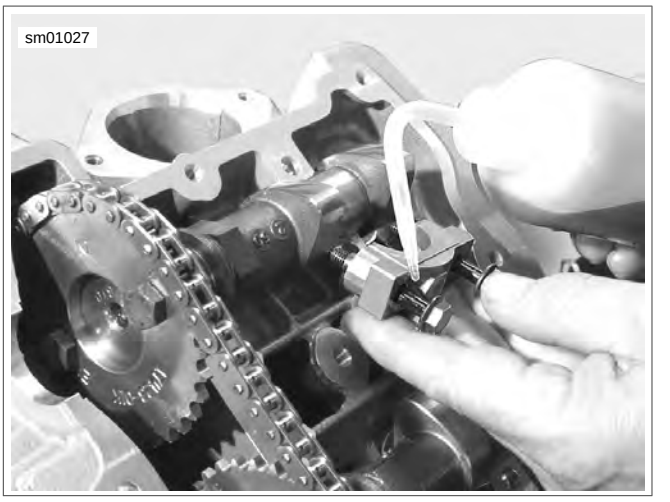


Figure 3-46. Lubricate Journal Caps and Fasteners

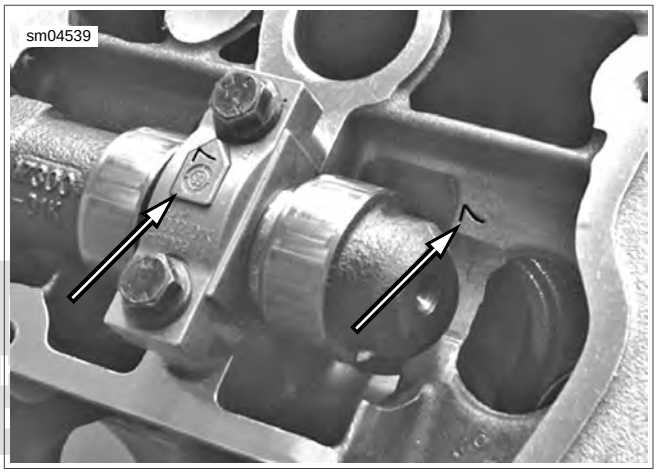


Figure 3-47. Cam Journal Cap Numbering and Directional Arrow (exhaust cam shown)

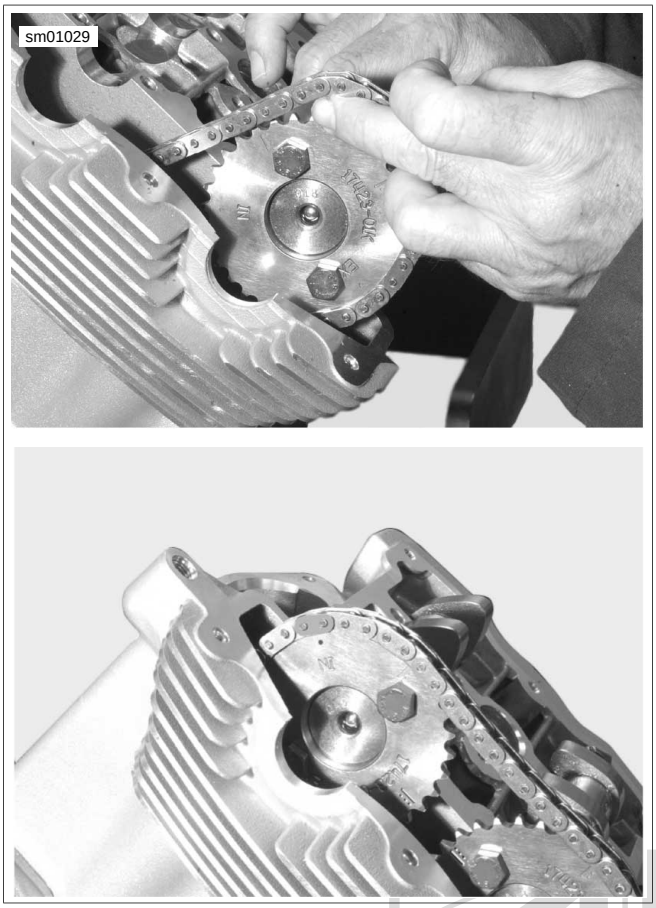


Figure 3-48. Rear Cylinder Cams

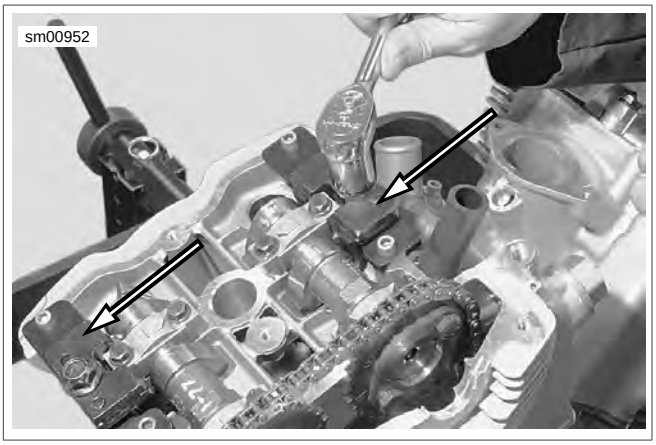


Figure 3-49. Tappet Compressing Tools (typical)

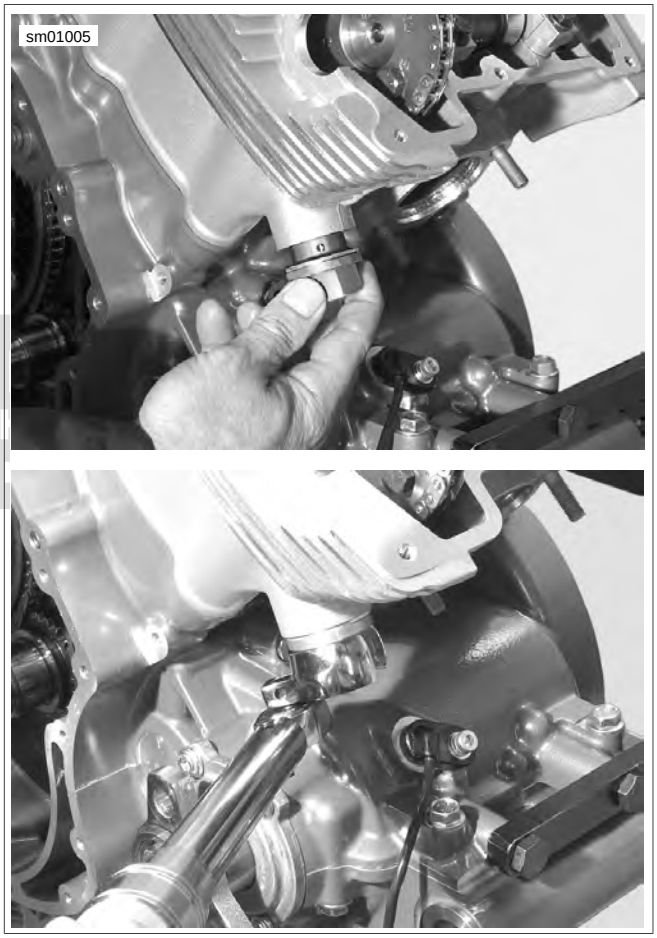


Figure 3-50. Rear Cylinder Cam Chain Tensioner

NOTICE

Never rotate engine with secondary cam chain tensioner removed. Engine damage and loss of correct timing will occur. (00545b)

14. See Figure 3-49. Install TAPPET COMPRESSING TOOL (Part No. HD-45491) on front cylinder.
 a. Loosen 19 mm nut on tappet compressing tool.
 b. Using the cam cover fasteners, install the tappet compressing tool.
15. Tighten 19 mm nut to compress tappets.
16. See Figure 3-44. Insert front cylinder cam drive chain down from the front head. Wrap chain around front row of triple sprocket teeth with the copper chain links (16) straddling the triple gear timing mark.
17. Lubricate cam journals, lobes, and tappets with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, apply a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE.
18. Insert front exhaust cam into cylinder head and align copper link (1) straddling the single dot timing mark (2).
19. Insert front intake cam into cylinder head and align copper link (6) straddling the single dot timing mark (5).

NOTES

- *Finger-tighten cam journal caps before applying torque.*
- *If not on base circle, do not attempt to install journal caps without first relieving valve spring pressure using tappet compressing tool. Failure to follow this procedure will result in damage to cylinder head.*

20. Install and tighten cam journal caps to 9.7 Nm (86 **in-lbs**).

21. Verify that:
 a. The single copper link (6) on the cam drive chain straddle the single dot (5) on the intake cam sprocket.
 b. The single copper link (1) on the cam drive chain straddles the single dot (2) on the exhaust cam sprocket.
 c. The two dot timing line (4) on the intake cam sprocket is aligned with the one dot timing line (3) on the exhaust cam sprocket.
 d. The front intake and exhaust cam lobes (18, 19) are positioned as illustrated.

NOTE

Compare lobe positions of each cam shaft to Figure 3-44. If timing marks are correct but camshaft lobes are incorrect, the drive sprocket could be installed incorrectly on the camshaft.

22. Remove TAPPET COMPRESSING TOOL (Part No. HD-45491).
23. Install front cylinder secondary cam chain tensioner and tighten to 100 Nm (74 ft-lbs).
24. Remove TDC POSITIONING TOOL (Part No. HD-45653) from front cylinder spark plug hole.
25. Check valve lash and adjust as necessary. See 1.20 VALVE LASH.

NOTES

- *If performing a major engine overhaul, conduct a leak down test before mating engine cases.*
- *Verify CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316) is installed prior to performing leakdown test.*

26. Install and tighten spark plugs to 23 Nm (17 ft-lbs).

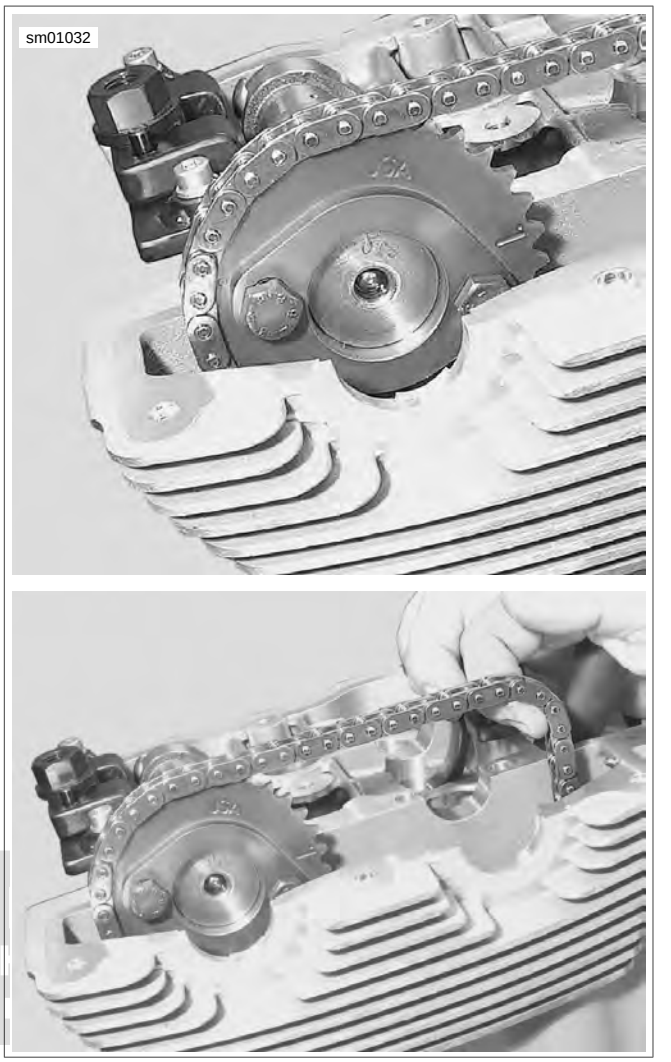


Figure 3-51. Cam Chain Alignment

27. Clean cam covers and install **new** gaskets. The rectangular tab fits in the corresponding knockout around the gasket groove in the head.
28. See Figure 3-52. Use cable straps (1) to help retain gasket as shown.
29. Visually check to verify spark plug hole gasket (2) is in place.

NOTICE

Spark plug hole gasket must be installed with double lip side facing cylinder head to avoid oil leaking into spark plug hole. (00547b)

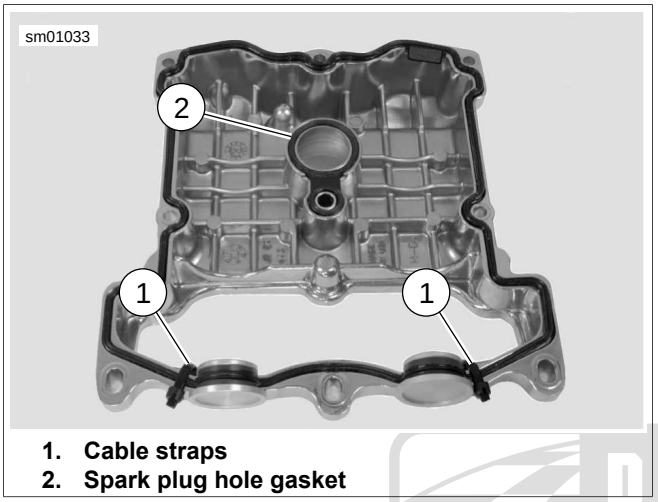
NOTE

Use a small amount of HARLEY-DAVIDSON HIGH PERFORMANCE SEALANT to hold position of spark plug hole and cam cover gaskets (excluding camshaft half-moons) during assembly.

30. Apply a 1 mm (0.04 in.) bead of HARLEY-DAVIDSON HIGH PERFORMANCE SEALANT along gasket recesses in cylinder head, not including camshaft half-moon areas.

Cam cover gasket **must** stay in place. A small amount of sealant, lightly applied will help.

31. See Figure 3-52. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.
32. Remove cable straps.
33. Place small cam cover in position.
34. Insert GASKET ALIGNMENT DOWELS (Part No. HD-45340).
35. See Figure 3-54. Install fasteners in cam cover and tighten to 11 Nm (97 **in-lbs**) in sequence.



1. **Cable straps**
2. **Spark plug hole gasket**

Figure 3-52. Cam Cover Gaskets



Figure 3-53. Spark Plug Hole Gasket (double lipped side)

36. Install alternator cover. See 7.19 ALTERNATOR.

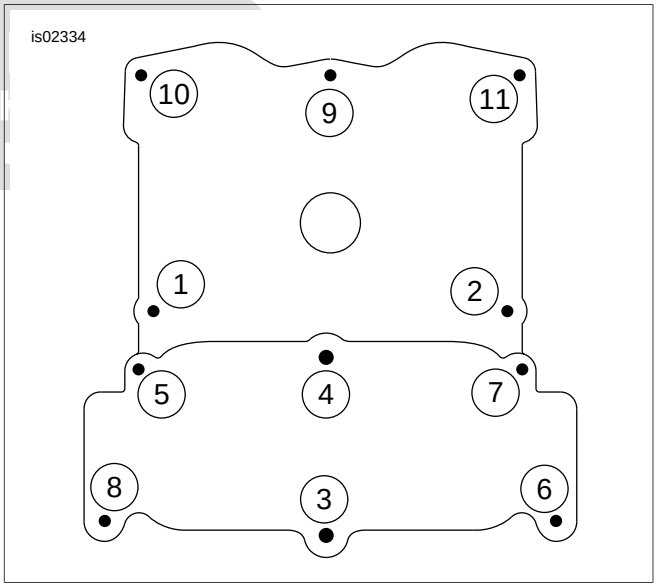


Figure 3-54. Cam Cover Torque Sequence

37. Install oil pump. See 3.13 OIL PUMP.
38. Install clutch and clutch cover. See 6.3 CLUTCH.
39. Install water pump. See 5.6 WATER PUMP.

NOTE

To continue engine overhaul, proceed to 6.4 TRANSMISSION.

CYLINDER HEAD 3.10

REMOVAL

PART NUMBER	TOOL NAME
1MFLE140 SNAP-ON	SOCKET
HD-39786	CYLINDER HEAD HOLDING FIXTURE
HD-45312	CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER
HD-45333	CYLINDER HEAD HOLDER
HD-45491	TAPPET COMPRESSING TOOL

NOTES

- *If cylinder head, crankcase or transmission work needs to be performed, engine must be removed from chassis. See 3.11 UPPER AND LOWER CRANKCASE SEPARATION.*
- *TAPPET COMPRESSING TOOL (Part No. HD-45491) is in place from the cam drive removal process, remove it before proceeding. Removing the head with valves extended could result in damage.*

1. See Figure 3-55. Remove seven fasteners retaining head.
 a. Completely remove the three 5mm fasteners (1, 2, 3).
 b. The four main headbolts (4, 5, 6, 7) are external TORX E14. Use SOCKET (Part No. 1MFLE140 Snap-on) tool to loosen main headbolts in a crisscross pattern until free.
2. Remove the cylinder heads.
3. See Figure 3-56. Use CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) and CYLINDER HEAD HOLDER (Part No. HD-45333) to secure cylinder head for service.

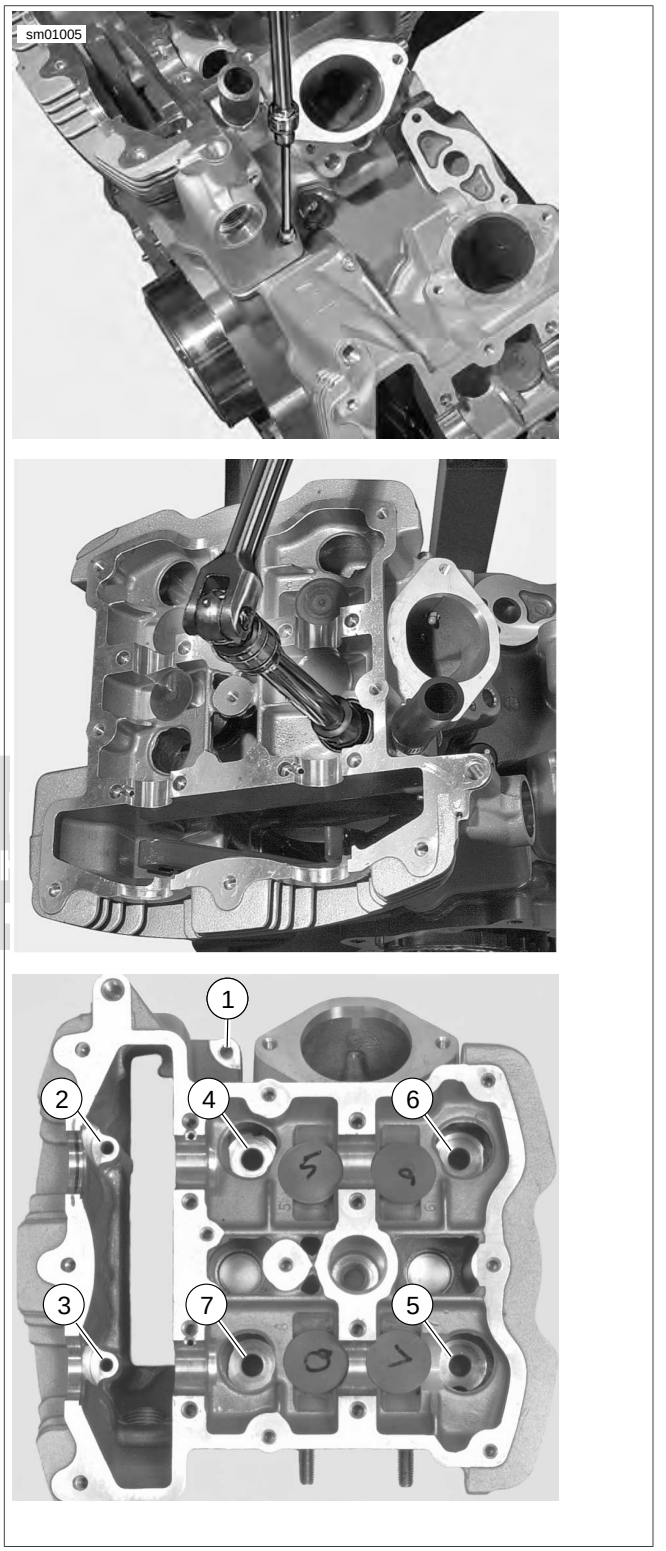


Figure 3-55. Cylinder Head Fasteners



Figure 3-56. Cylinder Head Holder

4. See Figure 3-57. Use CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER (Part No. HD-45312) to remove cam chain tensioner pins.

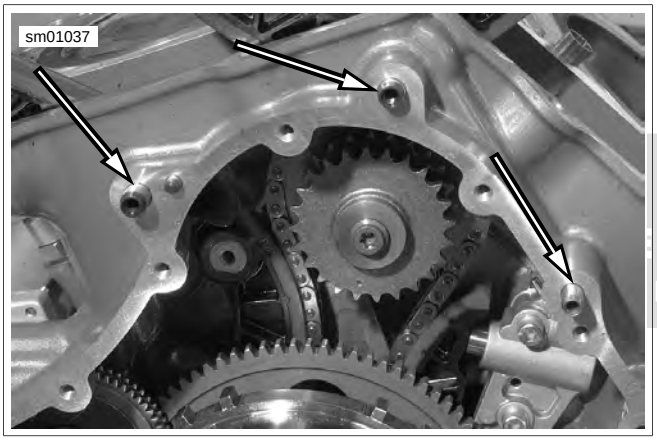


Figure 3-57. Cam Chain Tensioner Guide Pins

NOTE

To continue engine disassembly, go to STEP 6 of 3.11 UPPER AND LOWER CRANKCASE SEPARATION.

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-34736-B	VALVE SPRING COMPRESSOR
HD-34751	VALVE GUIDE CLEANING BRUSH
HD-35758-51	6 MM PILOT
HD-39782	CYLINDER HEAD SUPPORT STAND
HD-39782-13	CYLINDER SUPPORT ADAPTER
HD-39782-14	CYLINDER SUPPORT ADAPTER
HD-45319	VALVE GUIDE REAMER
HD-45320	VALVE GUIDE REMOVER/INSTALLER
HD-45321	VALVE GUIDE FLEX HONE
YA8230	SNAP-ON VALVE STEM SEAL PLIERS

1. See Figure 3-58. Clean oil film from tappets and use marker to number tappets according to the cast in number at each valve. Remove tappets and shims and keep together for assembly in same position.

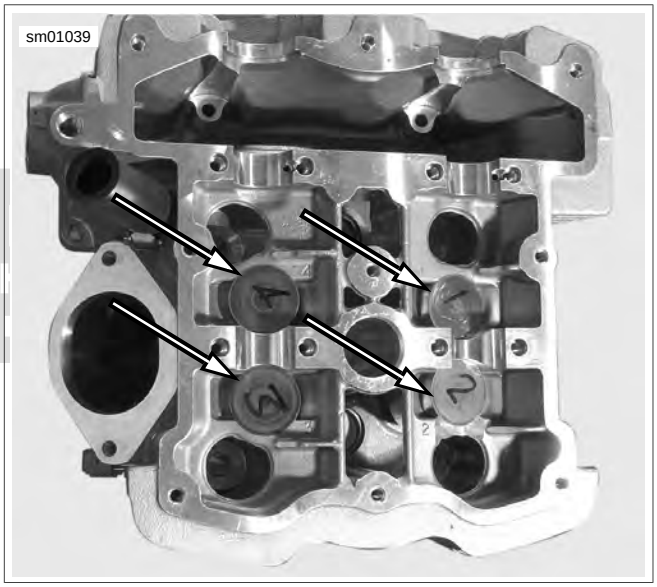


Figure 3-58. Number Tappets

2. See Figure 3-59. Install VALVE SPRING COMPRESSOR (Part No. HD-34736-B). Remove valves, springs and keepers. Keep removed parts organized so they will be assembled in same position.



Figure 3-59. Valve Spring Compressor

3. See Figure 3-60. Check valve spring free height and compression force at installed and compressed heights. Refer to Table 3-6. Replace if not within specification.

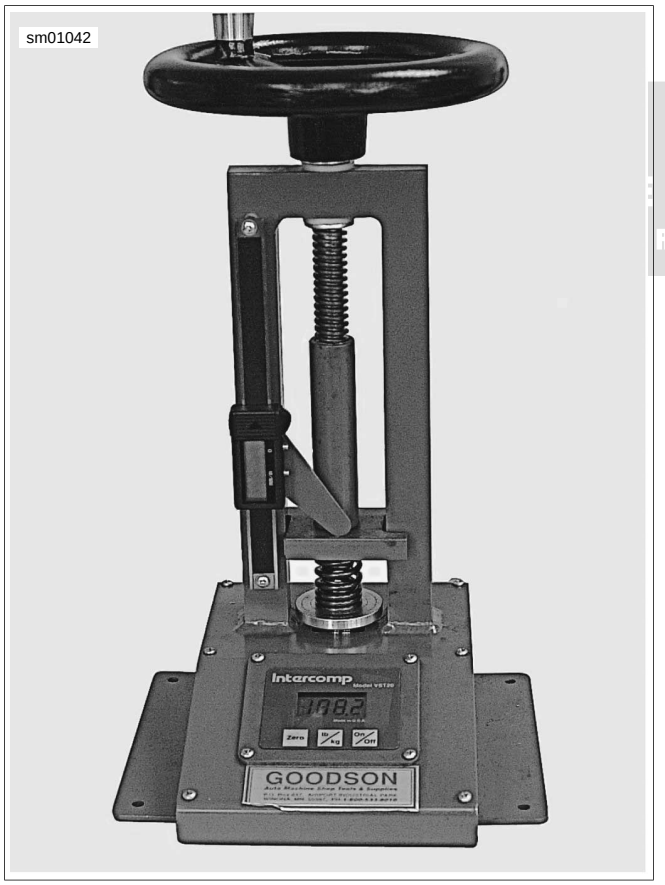


Figure 3-60. Testing Valve Spring

4. See Figure 3-61. Remove valve guide seal with SNAP-ON VALVE STEM SEAL PLIERS (Part No. YA8230).

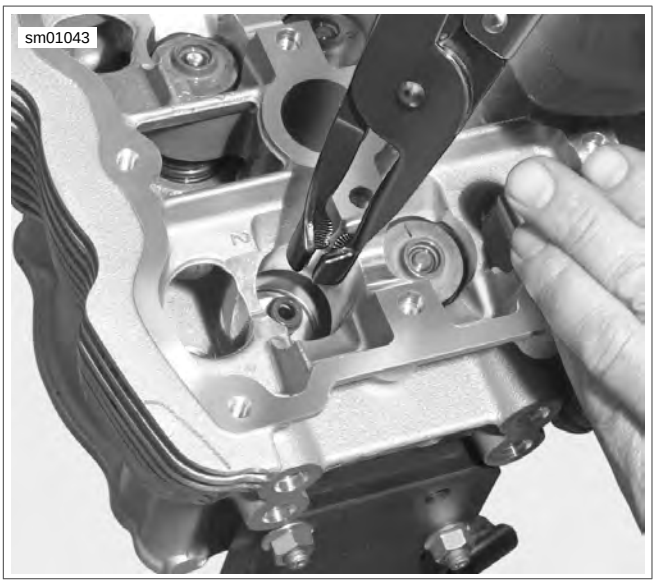


Figure 3-61. Valve Seal

5. See Figure 3-62. Measure valve stem diameter and valve guide bore.

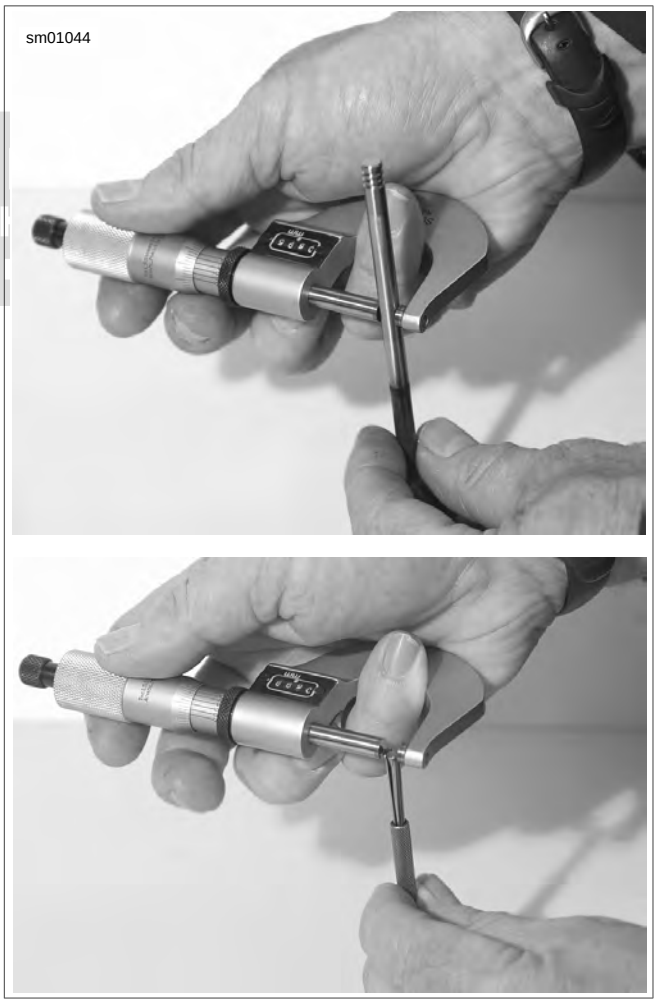


Figure 3-62. Measure Stem to Guide Clearance

6. Subtract the valve stem measurement from the valve guide bore measurement to calculate the running clearance.

7. Compare the measurements to Table 3-22.

Table 3-22. Valve Guide Running Clearance

VALVE GUIDE		MM	IN
Intake	Min	0.0285	0.0012
	Max	0.0585	0.0023
Exhaust	Min	0.0385	0.0016
	Max	0.0685	0.0026

NOTE

Do not remove valve guides that are within valve guide running clearance. Refer to Table 3-22.

8. See Figure 3-63. Remove and replace the valve guides that do not meet specifications. Position head for removal of valve guide. Use CYLINDER HEAD SUPPORT STAND (Part No. HD-39782) with CYLINDER SUPPORT ADAPTER (Part No. HD-39782-13) for intake valves and CYLINDER SUPPORT ADAPTER (Part No. HD-39782-14) for exhaust valves.



Figure 3-63. Valve Guide Removal (typical)

9. Measure cylinder head valve guide bore to determine valve guide diameter needed. Select valve guide no larger than 0.051 mm (0.0020 in.) to 0.022 mm (0.00086 in.) over size of cylinder head valve guide bore.

10. See Figure 3-64. Use VALVE GUIDE REMOVER/INSTALLER (Part No. HD-45320) to install valve guide at correct height.

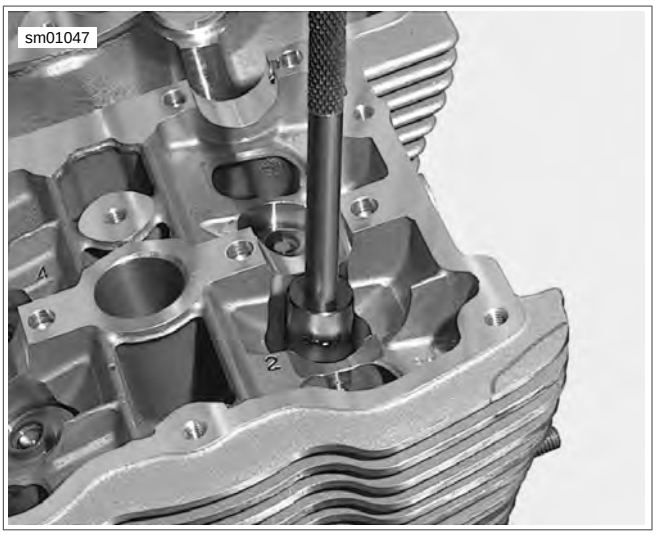


Figure 3-64. Valve Guide Installation

11. See Figure 3-65. Use VALVE GUIDE REAMER (Part No. HD-45319) to return installed guide to correct diameter.

12. See Figure 3-66. Use VALVE GUIDE FLEX HONE (Part No. HD-45321) to get the correct surface finish for proper valve stem-to-guide fit and lubrication.

13. See Figure 3-67. Clean valve guide with VALVE GUIDE CLEANING BRUSH (Part No. HD-34751).

14. See Figure 3-68. Verify stem to guide clearance is correct after reaming.

15. Clean valve stem bore and insert 6 MM PILOT (Part No. HD-35758-51) in bore.

NOTE

ALWAYS clean valve stem bore before inserting pilot. Clean bores of all valve guides not replaced as well.



Figure 3-65. Ream Valve Guide

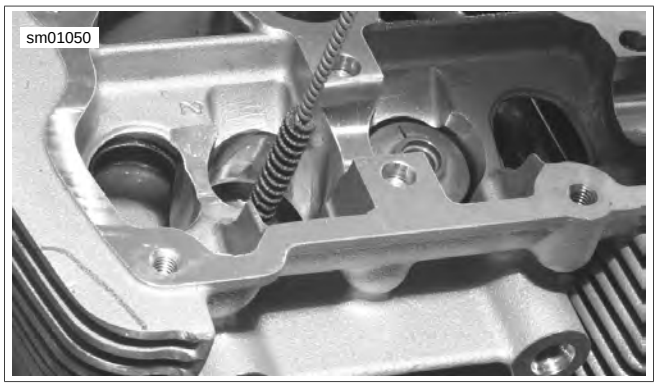


Figure 3-66. Hone Valve Guide

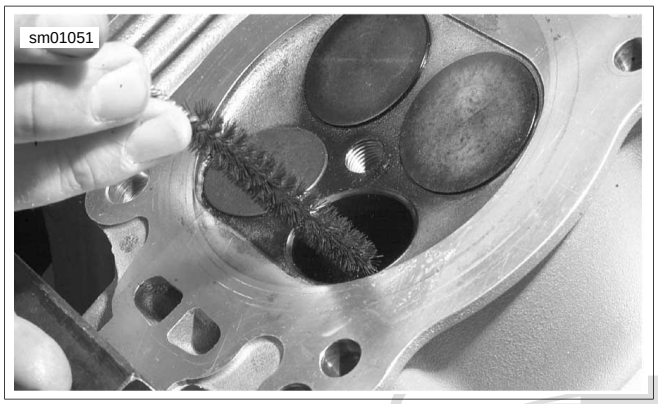


Figure 3-67. Valve Guide Cleaning Brush

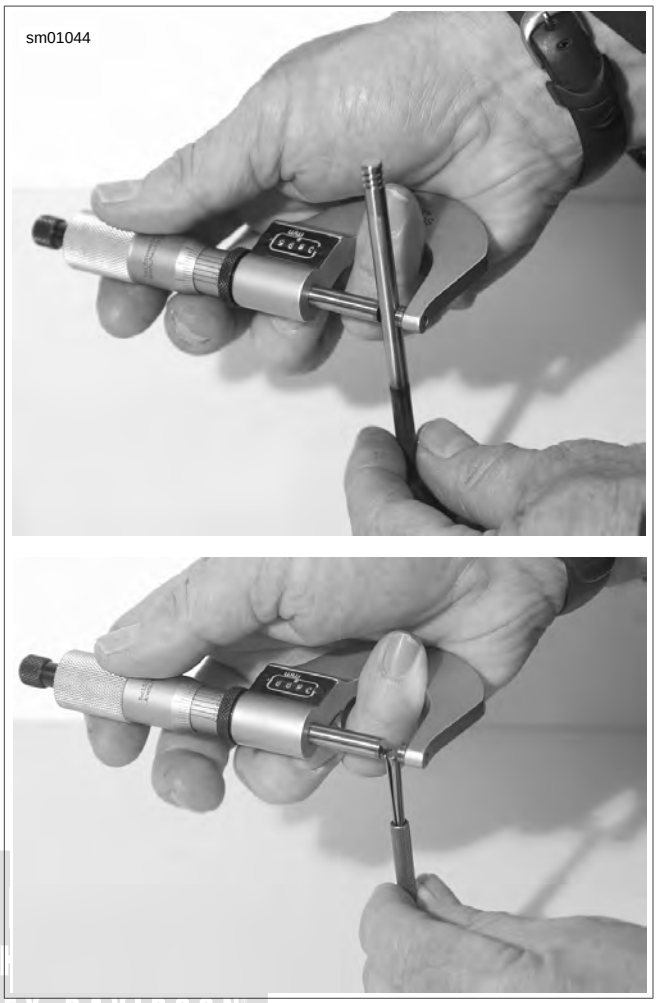


Figure 3-68. Measure Stem to Guide Clearance

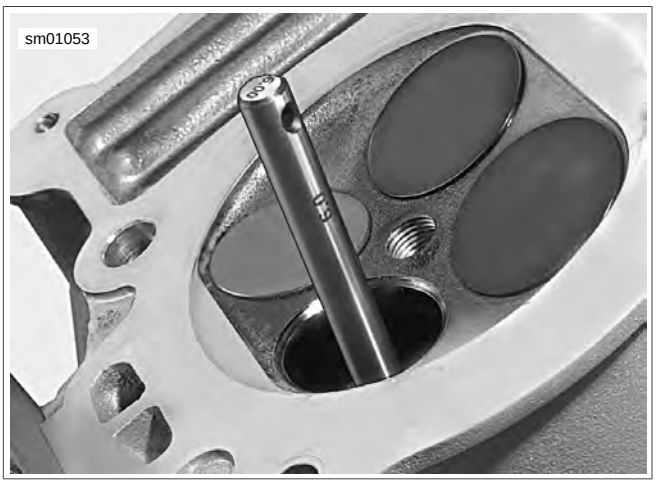


Figure 3-69. 6 mm Pilot

VALVE SEAT REFACING

PART NUMBER	TOOL NAME
HD-34751	VALVE GUIDE CLEANING BRUSH
HD-35758-50	NEWAY VALVE SEAT CUTTER SET
HD-39786	CYLINDER HEAD HOLDING FIXTURE
HD-45333	CYLINDER HEAD HOLDER

NOTES

- *Verify correct valve stem to valve guide clearance before refacing. Refer to Table 3-23. If **new** guides must be installed, complete that task before refacing valves and seats.*
- *This procedure is not based on the lapping of valves. The end result is an interference fit between the valve of 45 degrees and the valve seat which will be 46 degrees.*

1. See Figure 3-70. Use CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) and CYLINDER HEAD HOLDER (Part No. HD-45333) to secure cylinder head for service.
2. Clean valve seats and valve faces.
3. Insert the valve stem into the valve guide.
4. Measure valve stem protrusion.
 a. Holding valve against seat, measure distance from top of valve stem to face of spring pocket in cylinder head.
 b. Compare measurement to maximum and minimum in Table 3-23.
 c. If valve stem protrusion exceeds maximum, replace valve seat or cylinder head as necessary.
 d. If valve stem protrusion is less than the minimum, reface the valve seat until the measurement of valve protrusion is within specifications.

Table 3-23. Valve Stem Protrusion

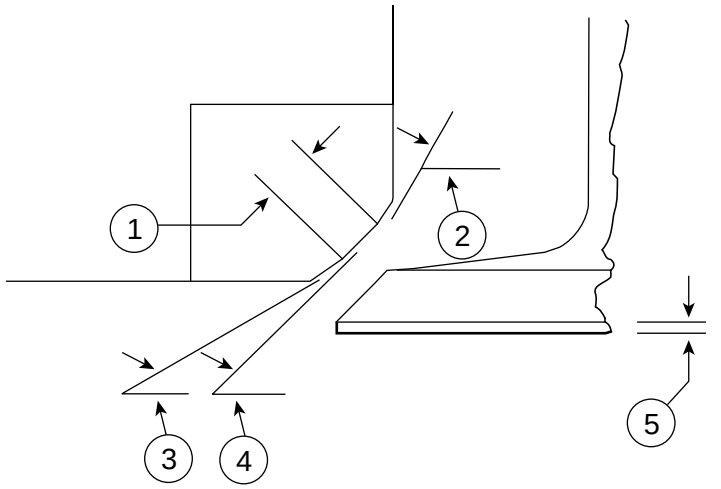
ITEM	MM	IN
Intake	Max 44.771	1.762
	Min 44.171	1.739
Exhaust	Max 43.893	1.728
	Min 43.293	1.704



Figure 3-70. Cylinder Head Holder

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

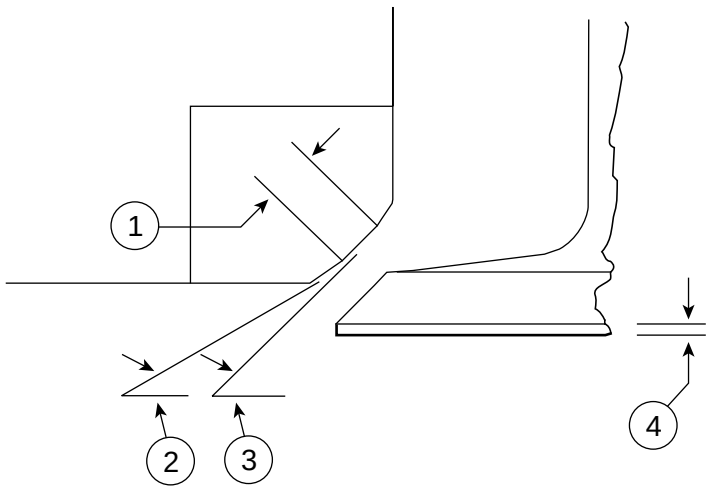
sm01054



1. **Min. 0.750 mm (0.029 in.) Max. 0.860 mm (0.033 in.)**
2. **70 degree**
3. **30 degree**
4. **46 degree**
5. **Min. 0.795 mm (0.0313 in.)**

Figure 3-71. Intake Valve and Seat

sm01055



1. **Min. 1.05 mm (0.041 in.) Max. 1.170 mm (0.046 in.)**
2. **30 degree**
3. **46 degree**
4. **Min. 0.795 mm (0.0313 in.)**

Figure 3-72. Exhaust Valve and Seat

NOTE

Do not remove any more metal than is necessary to provide a uniform finish and remove pitting from seat.

5. From the NEWAY VALVE SEAT CUTTER SET (Part No. HD-35758-50) use # 622 for intake or # 203 for exhaust and cut valve seat angle to 46 degrees.
6. In order to determine the correct location of the 46 degree valve seat in the head, measure the width of the valve to be used and subtract 1.02 mm (0.040 in.) from that number.
7. Set dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.
8. Use a permanent marker to highlight the valve seat area to be cut and be sure to highlight all three angles. Allow marker to dry before proceeding.

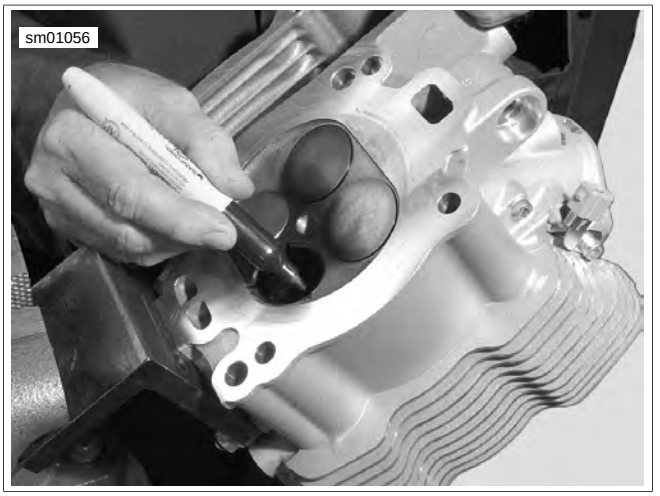


Figure 3-73. Mark Valve Seat

NOTE

Always be sure cutter blades and cutter pilot are clean before beginning the cutting process. Also be sure the inside of the valve guide is clean by using Kent-Moore VALVE GUIDE CLEANING BRUSH (Part No. HD-34751).

9. Choose the cutter pilot that fits properly into the valve guide hole. Securely seat the pilot by pushing down and turning with the installation tool.
10. Gently slide the cutter onto the pilot being careful not to drop the cutter onto the seat.

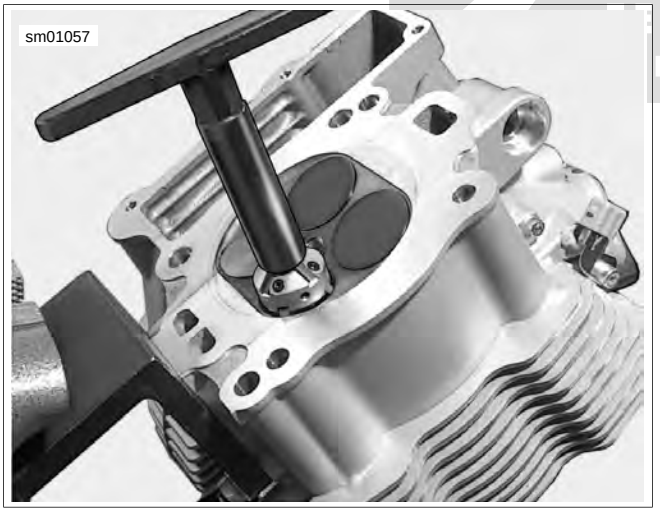


Figure 3-74. Neway Cutter

11. While applying a constant and consistent pressure, remove just enough material to show a complete clean-up on the 46 degree angle.

NOTES

- *If the width of the clean-up angle is greater on one side of the seat than the other, the guide may need to be replaced due to improper installation.*
- *If a groove cut completely around the seat is seen, the blades of the cutter are nicked and need to be staggered. Loosen all of the blades and move each one slightly in opposite directions on the cutter.*

12. See Figure 3-71 and Figure 3-72. With dial caliper locked to the predetermined setting, measure the outermost edge to determine which cut needs to be made next.
 a. If the 46 degree cut is too high (toward the combustion chamber), use the 30 degree cutter to lower the valve seat.
 b. If the 46 degree cut is too low, and the width of the valve seat is too wide, use the 70 degree (intake only) cutter to raise the valve seat or move it away from the port.

NOTES

- *Due to using the top measurement of our valve seat as a reference point it will usually be necessary to use the 30 degree cutter following the initial 46 degree cut.*
- *Do not cut the bottom angle on the exhaust seat.*
- *Always highlight the valve seat with the permanent marker in order to verify the location of the 46 degree valve seat.*

13. If the location of the valve seat is not correct, repeat above steps.
14. When the 46 degree angle is properly located and the width is at least 0.750 mm (0.029 in.) for intake or 1.050 mm (0.041 in.) for exhaust, proceed to the next step.
15. **Intake Only:** Using a 70 degree cutter, remove just enough material to provide the proper valve seat width.
16. Remove cutter pilot and wash head thoroughly and dry completely.
17. Repeat the process on any valve seat that needs service.
18. Insert valve to be used in the valve guide and bottom on the valve seat. Positioning the cylinder head port upwards and with slight thumb pressure against the valve, fill the port with solvent to verify proper seal between the valve and the valve seat.

NOTE

Hold pressure against the valve for a minimum of 10 seconds. If any leakage occurs, examine the valve seat for irregularities or defects and, if necessary, repeat the above cutting process.

HEAD ASSEMBLY

PART NUMBER	TOOL NAME
HD-34736-B	VALVE SPRING COMPRESSOR
HD-45322	VALVE GUIDE SEAL INSTALLER

FASTENER	TORQUE VALUE	
Cam journal caps	9.7 Nm	86 **in-lbs**

1. Thoroughly clean head before beginning assembly.
2. Verify valve springs are within recommended specification. Refer to Table 3-7.
3. See Figure 3-75. Insert lower spring collar.

4. Lubricate valve with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 and position in cylinder head.
5. See Figure 3-76. Place tapered pin of VALVE GUIDE SEAL INSTALLER (Part No. HD-45322) over valve stem and position **new** seal on the tapered pin. Drive seal into position.

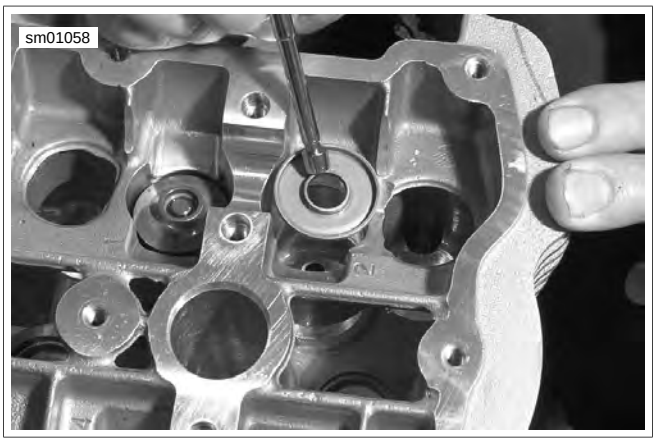


Figure 3-75. Lower Spring Collar

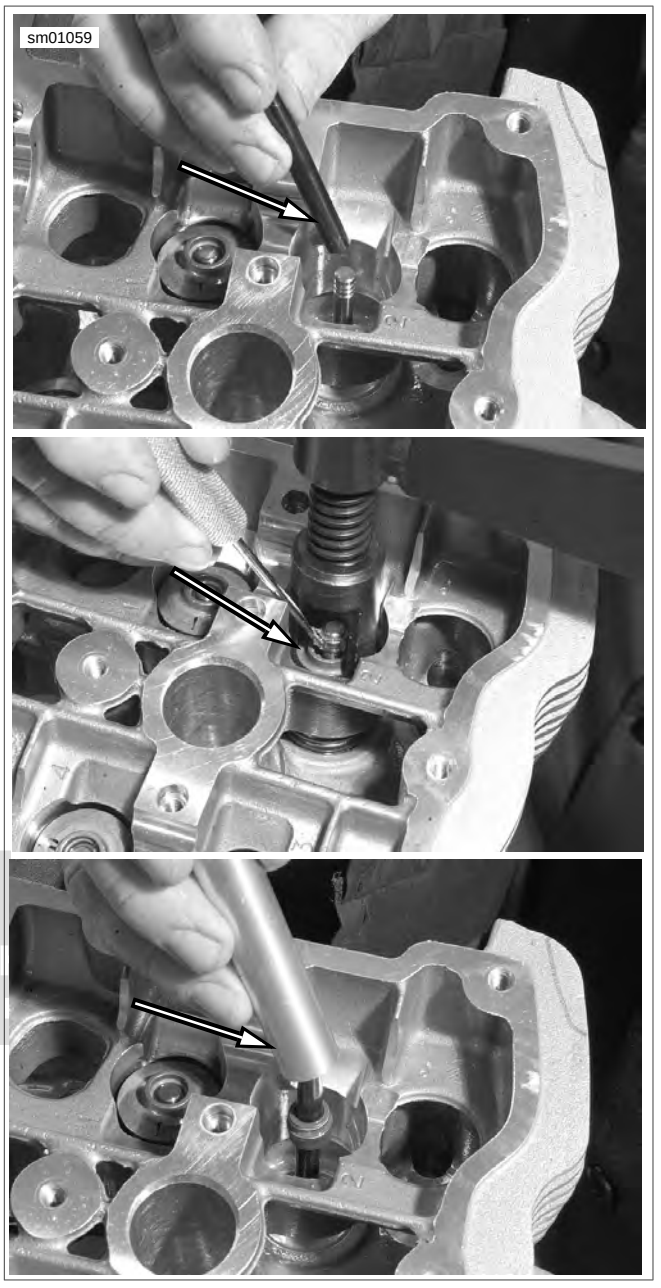


Figure 3-76. Valve Seal Installation

6. See Figure 3-77. Install upper spring collar and valve spring with tightly wound coils to the bottom.
7. See Figure 3-78. Install VALVE SPRING COMPRESSOR (Part No. HD-34736-B) and compress spring to expose valve stem. Apply a light grease around the valve stem to hold keepers in position when relaxing the compressor tool.
8. Install valve keepers and remove compressor tool.
9. Using a micrometer measure and record for reference all valve shims.
10. Install all valve shims in their original location. Use a magnet to position the shim and push into place with finger.
11. Install tappets in their original locations.

12. Lubricate cam journals, lobes, and tappets with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE is recommended.
13. See Figure 3-79. Install cams and cam journal caps. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).

NOTE

To accurately check valve lash, cam journal caps MUST be tightened to specification.

14. See Figure 3-80. Using a blade type feeler gauge measure valve lash. See 1.20 VALVE LASH, Lash Measurement and D.2 VALVE LASH CALCULATION WORKSHEET 1.
15. Adjust valve lash as required.

NOTE

Valve lash can be measured and adjusted before the heads are installed on engine. However, after head installation, valve lash should be measured and adjusted as required.



Figure 3-77. Valve Spring Coils

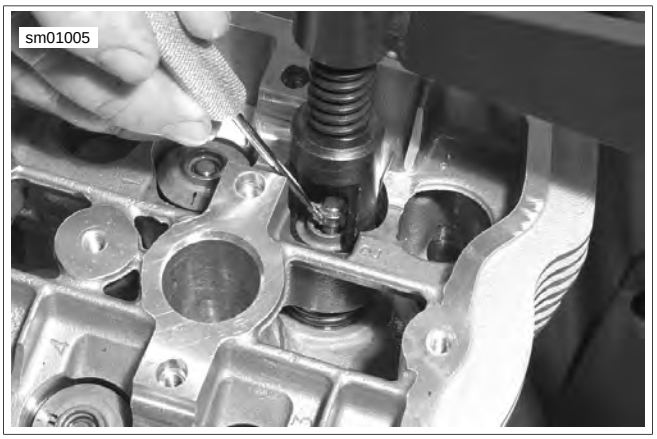


Figure 3-78. Install Valve Keepers

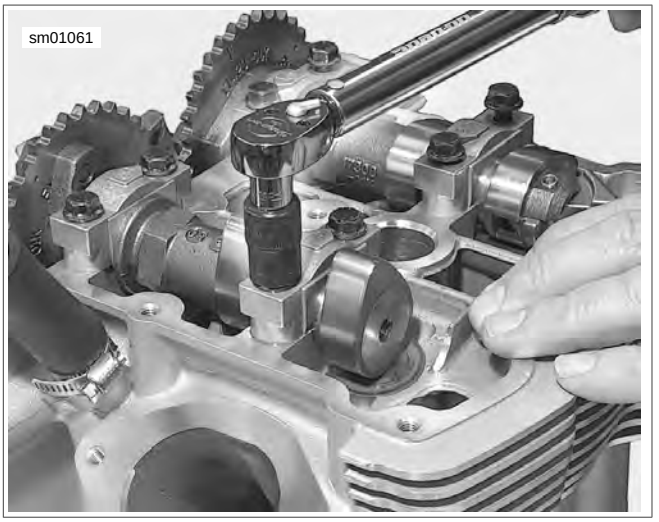


Figure 3-79. Tighten Cam Journal Caps

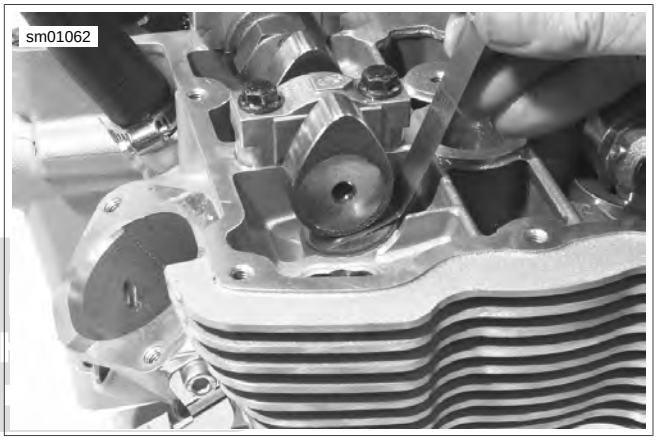


Figure 3-80. Check Valve Lash (typical)

INSTALLATION

PART NUMBER	TOOL NAME
SNAP-ON TA360	TORQUE ANGLE GAUGE

FASTENER	TORQUE VALUE	
* Cylinder head bolts; first torque then loosen one turn	35 Nm	26 ft-lbs
* Cylinder head bolts; second torque	20 Nm	15 ft-lbs
Head bolts, 6 mm	9.7 Nm	86 **in-lbs**

1. Install **new** head gasket on rear cylinder with TOP marking facing up.

NOTE

Head gaskets are different for each head and are marked TOP.

2. See Figure 3-81. Make sure tensioner guide is locked in head as shown.

NOTE

Tensioner guide position is the same in both rear and front cylinder head.

3. See Figure 3-82. Use GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 to lubricate the four main head bolt threads and under the bolt head.

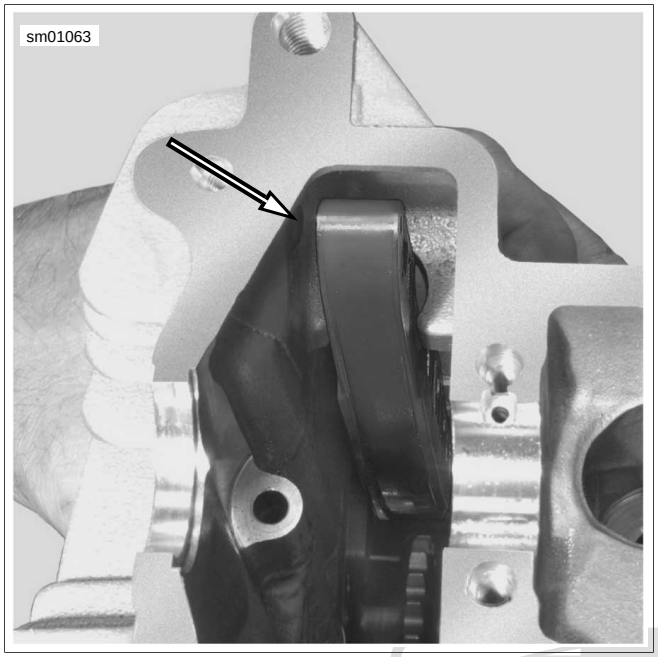


Figure 3-81. Tensioner Guide Position in Cylinder Head

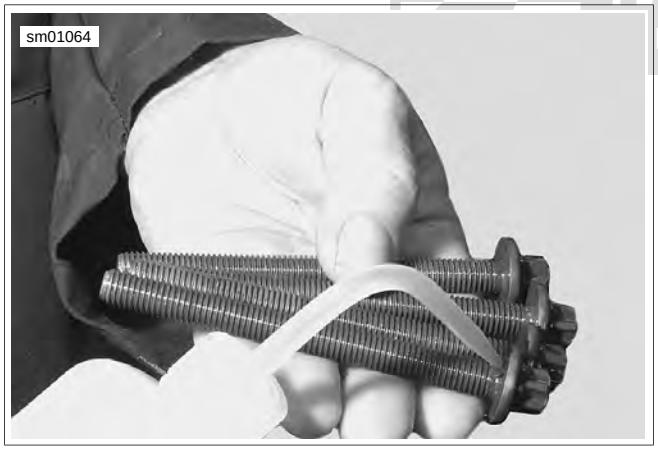


Figure 3-82. Lubricate Head Bolts

4. See Figure 3-83. Tighten four main head bolts in sequence.
 a. See Figure 3-84. Tighten to 35 Nm (26 ft-lbs).
 b. Loosen each bolt one full turn.
 c. Tighten to 20 Nm (15 ft-lbs).
 d. Tighten bolts an additional 90 degrees using TORQUE ANGLE GAUGE (Part No. SNAP-ON TA360).
5. See Figure 3-85. Install 6 mm head bolts. The two long bolts are installed in positions 6 and 7. The short bolt is installed in position 5.
6. Tighten 6 mm head bolts to 9.7 Nm (86 **in-lbs**).

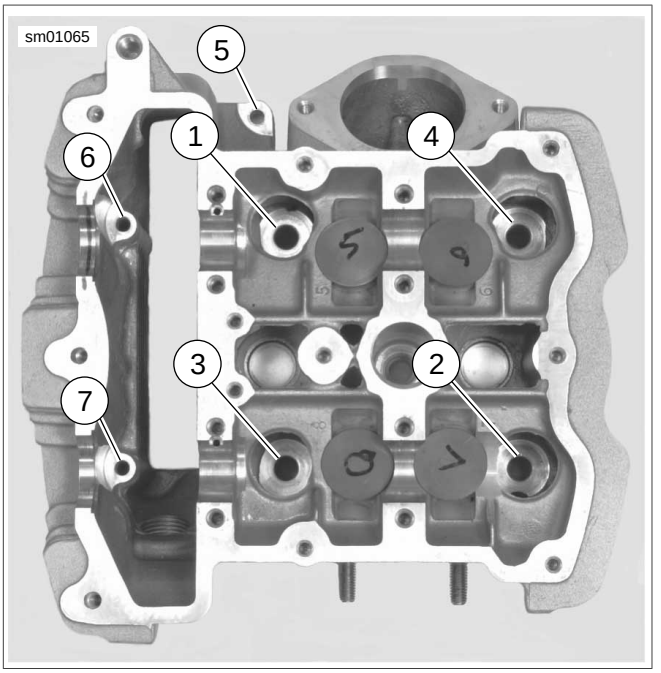


Figure 3-83. Head Bolt Torque Sequence (rear cylinder head)

NOTE

To continue engine rebuild, proceed to 3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation.



Figure 3-84. Tighten Head Bolts

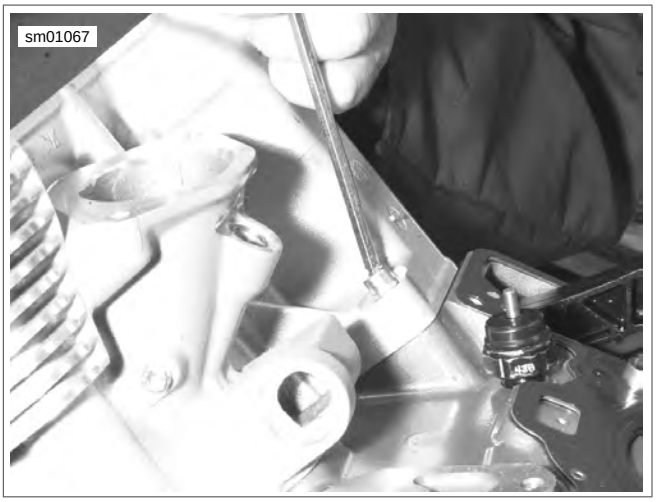


Figure 3-85. 6 mm Head Fasteners

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

UPPER AND LOWER CRANKCASE SEPARATION 3.11

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-45301	TRANSMISSION ASSEMBLY RETAINER TOOL
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER
HD-45340	GASKET ALIGNMENT DOWELS

1. Remove alternator derby cover.
2. See Figure 3-86. Remove the 14 fasteners on the alternator cover in reverse order of torque sequence.
3. Install GASKET ALIGNMENT DOWELS (Part No. HD-45340) in two of the alternator cover holes to steady the cover as it is removed.
4. See Figure 3-87. Using the inspection cover fasteners, position the ALTERNATOR STATOR COVER REMOVER/INSTALLER (Part No. HD-45304) as shown.
5. See Figure 3-88. Remove the alternator cover.
6. Remove the clutch side crankcase cover fasteners in reverse order of torque sequence. See 6.3 CLUTCH.
7. See Figure 3-89. Remove the clutch cover.
8. Remove clutch assembly. See 6.3 CLUTCH.

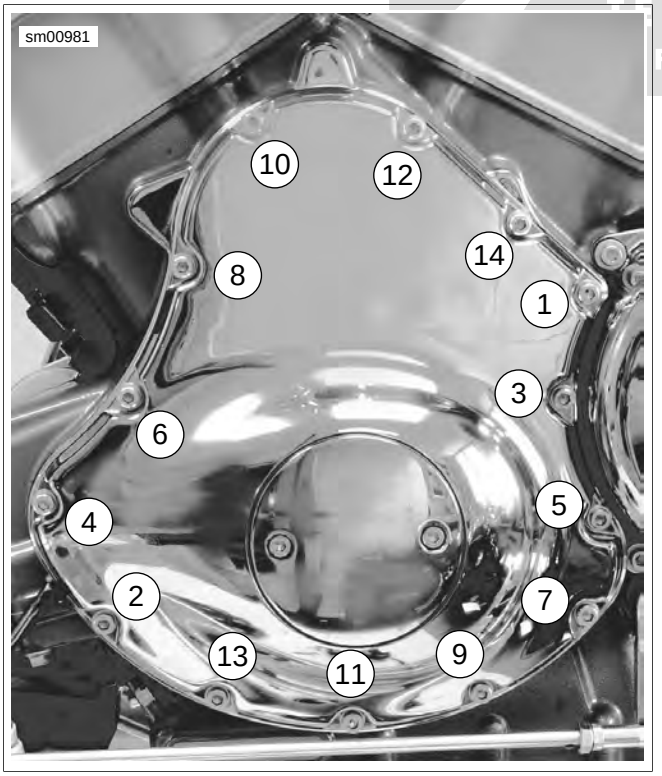


Figure 3-86. Alternator Cover Torque Sequence

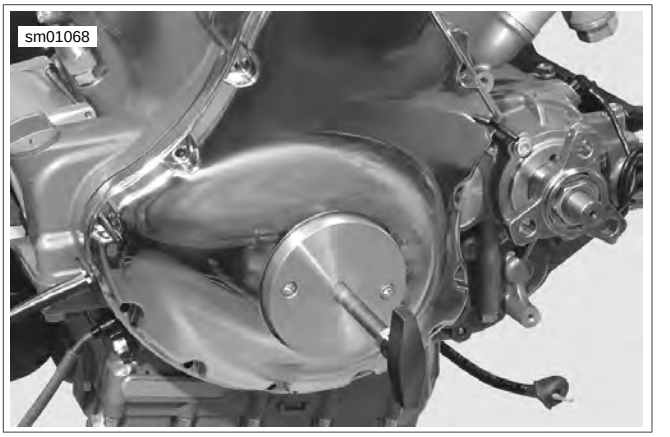


Figure 3-87. Alternator Stator Cover Remover/Installer

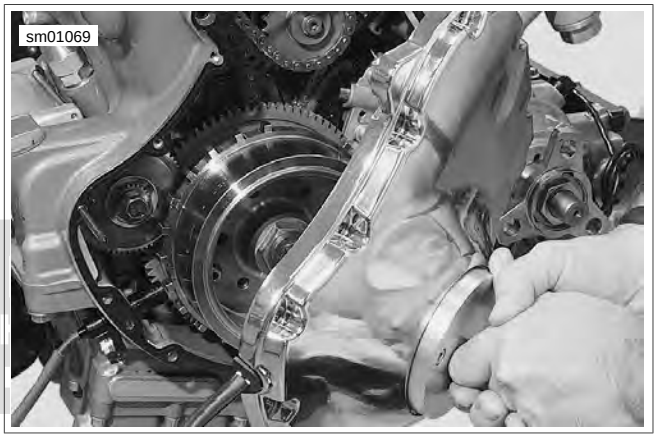


Figure 3-88. Remove Alternator Cover



Figure 3-89. Remove Clutch Cover

9. Remove oil pump from case. See 3.13 OIL PUMP.
10. Using a 1/2 in. drive extension and breaker bar, rotate engine in direction of normal engine rotation until timing marks on the crank gear and counterbalancer gear are aligned.

NOTICE

Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)

11. See Figure 3-90. Hold crankshaft with 1/2 in. drive extension and wrench to loosen counterbalancer drive gear fastener. The gear and fastener can be left in place or removed.

NOTES

- *The counterbalancer gear fastener can only be loosened before the case halves are separated and the crankshaft is still in place.*
- *If the alternator rotor is to be removed from the crankshaft, the rotor fastener can be loosened while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the starter limiter gear is to be removed, the starter limiter fastener can be loosened while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the cam drive is to be removed as part of top end disassembly, loosen the cam drive triple sprocket while holding the crankshaft drive gear with a 1/2 in. extension and wrench.*

12. See Figure 3-91. Carefully invert engine. Remove oil pan. Note position of engine ground cable for assembly.
13. See Figure 3-92. Remove oil pickup and gasket/baffle.

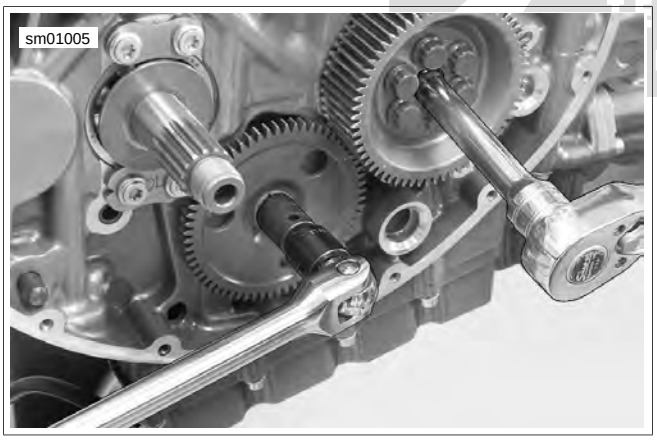


Figure 3-90. Crank Held to Loosen Fastener

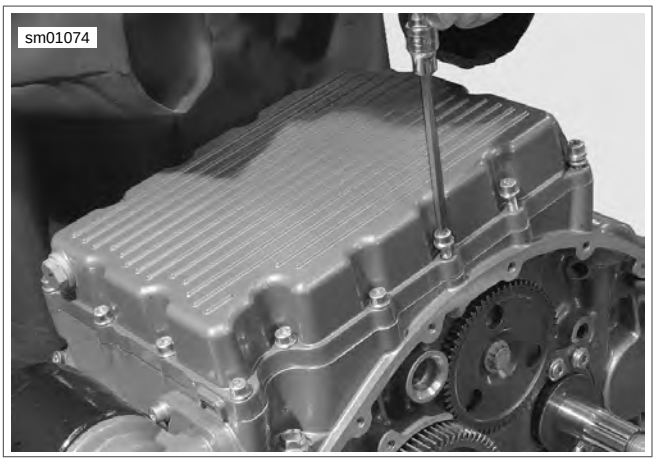


Figure 3-91. Oil Pan Removal



Figure 3-92. Oil Pickup

14. See Figure 3-93. Loosen, but do not remove, the input bearing retainer fasteners.
15. See Figure 3-94. Install TRANSMISSION ASSEMBLY RETAINER TOOL (Part No. HD-45301) on the input shaft.
16. See Figure 3-95. Loosen all four drive sprocket flange seal retainer fasteners. Remove the two fasteners from the upper case, leaving the loosened lower case fasteners in place. These fasteners will keep the transmission positioned in the lower crankcase.
17. See Figure 3-96. Remove the 19 case fasteners by first loosening each fastener 1/4 turn in reverse order of torque sequence to slowly relieve torque stress. Once all fasteners have been loosened 1/4 turn then they may be removed in the reverse order of torque sequence.

NOTE

Do not pry on sealing surfaces to separate case halves. Engine damage and/or case leaks may result.

18. Carefully separate the case halves. Use of a rubber mallet may be necessary to loosen the sealed case halves.

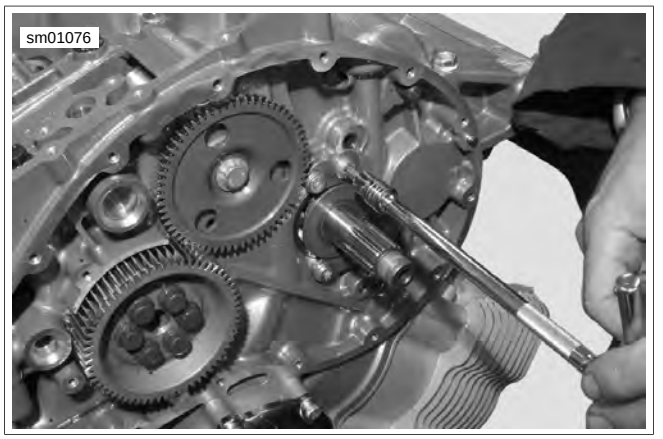


Figure 3-93. Input Bearing Retainer

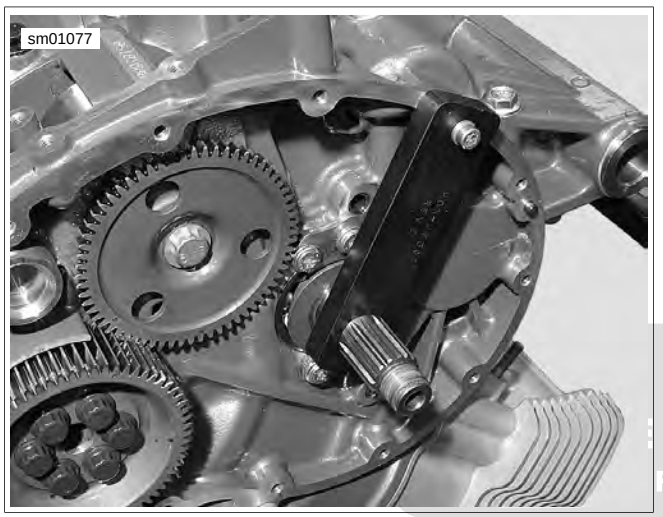


Figure 3-94. Input Shaft Retainer

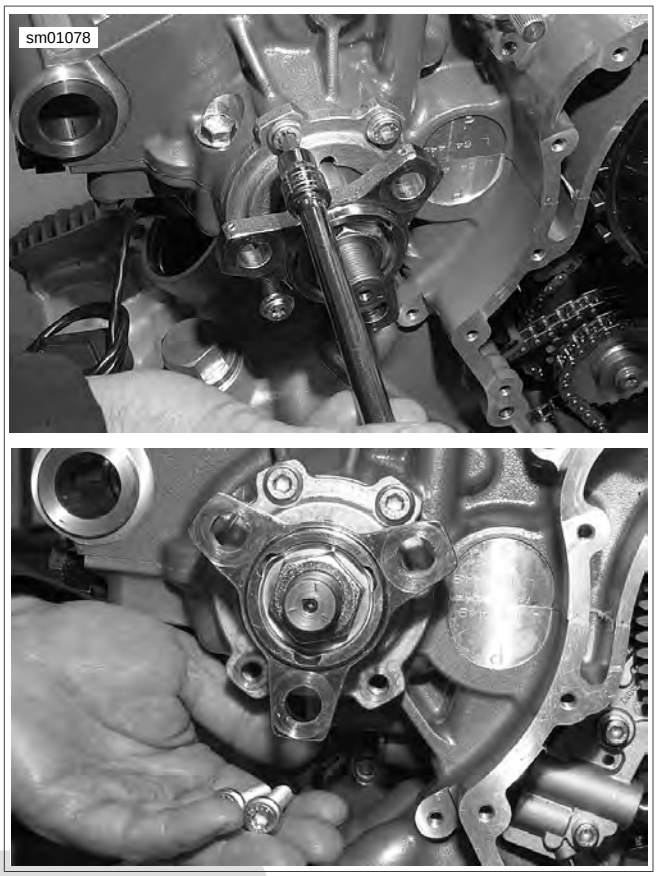
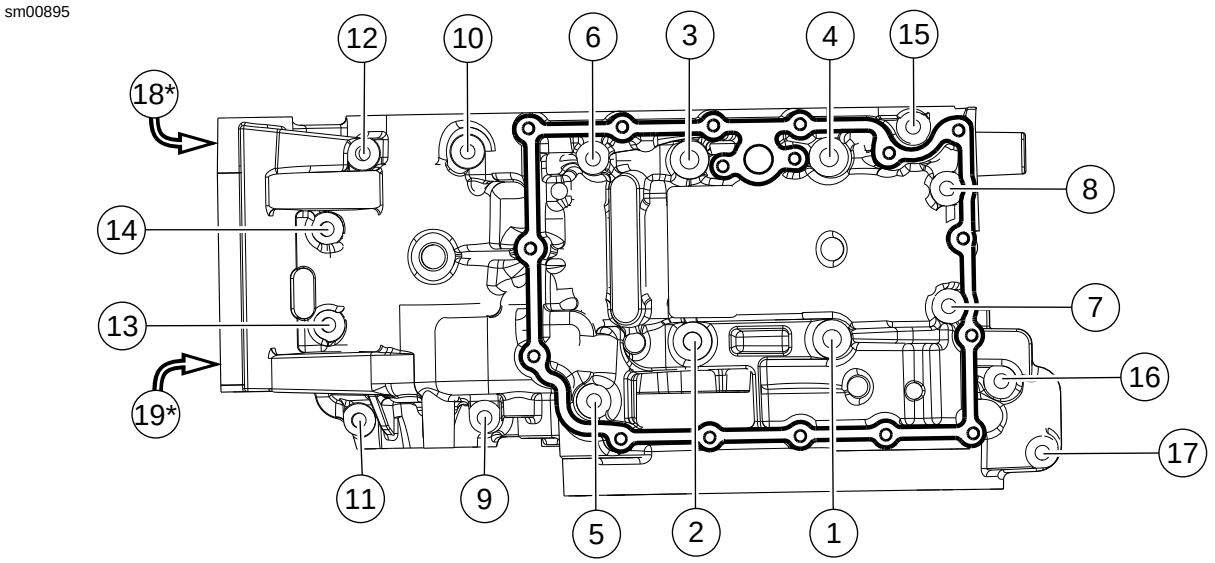


Figure 3-95. Drive Sprocket Flange Seal Retainer

IGITAL
CHNICIAN II
RLEY-DAVIDSON



1. **M10x150**
2. **M10x150**
3. **M10x150**
4. **M10x150**
5. **M8x120**
6. **M8x160**
7. **M8x90**
8. **M8x90**
9. **M8x120**
10. **M8x120**
11. **M8x40**
12. **M8x90**
13. **M8x40**
14. **M8x40**
15. **M8x90**
16. **M8x40**
17. **M8x40**
18. **M8x40 (*insert from upper case half)**
19. **M8x40 (*insert from upper case half)**

Figure 3-96. Engine Case Torque Sequence

NOTE

Lower case with the transmission gears in place is heavy. Have assistant help lift lower case.

19. Lift lower case by rear fork pivot housing and oil filter can.

NOTES

- *Whenever case halves are separated for service, the crankshaft bearings MUST BE REPLACED. Failure to replace bearings will result in engine damage.*
- *To continue engine disassembly, go to 3.12 ENGINE BOTTOM END SERVICE. For transmission service, see 6.4 TRANSMISSION.*

CRANKSHAFT, PISTON AND CYLINDER LINER REMOVAL/INSTALLATION

PART NUMBER	TOOL NAME
HD-44358	FLYWHEEL SUPPORT FIXTURE
HD-45313	CYLINDER LINER REMOVER/INSTALLER
HD-45316	CRANKSHAFT ASSEMBLY RETAINER
HD-47189	PISTON PIN REMOVAL AND INSTALLATION TOOL
HD-96333-105	PISTON RING COMPRESSOR
SNAP-ON TA360	TORQUE ANGLE GAUGE

FASTENER	TORQUE VALUE	
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs
* Primary gear fasteners; specification plus 60 degrees	15 Nm	132 **in-lbs**
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs

1. See Figure 3-97. Install CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316).

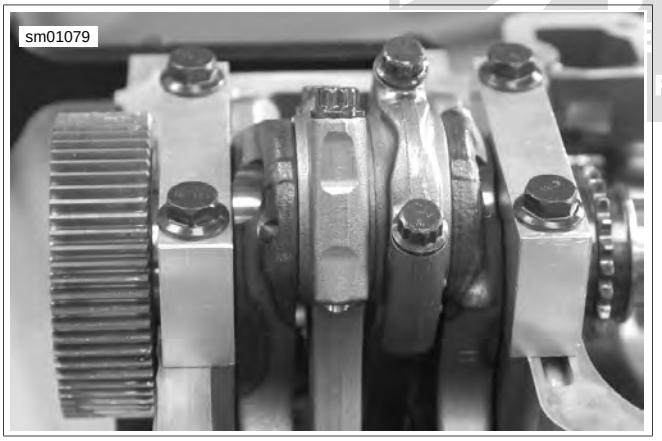


Figure 3-97. Install Crankshaft Assembly Retainers

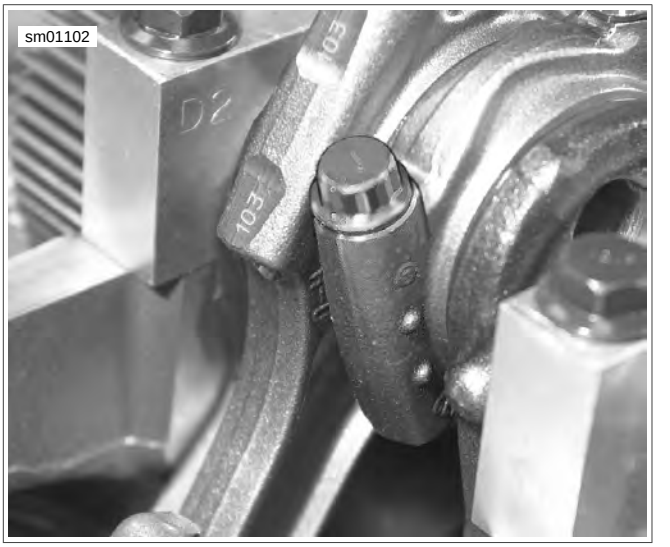


Figure 3-98. Connecting Rod Orientation

2. See Figure 3-98. Note the casting bumps on the connecting rods and caps. The rear cylinder must have the bumps toward the water pump side and the front cylinder toward the cam drive side.

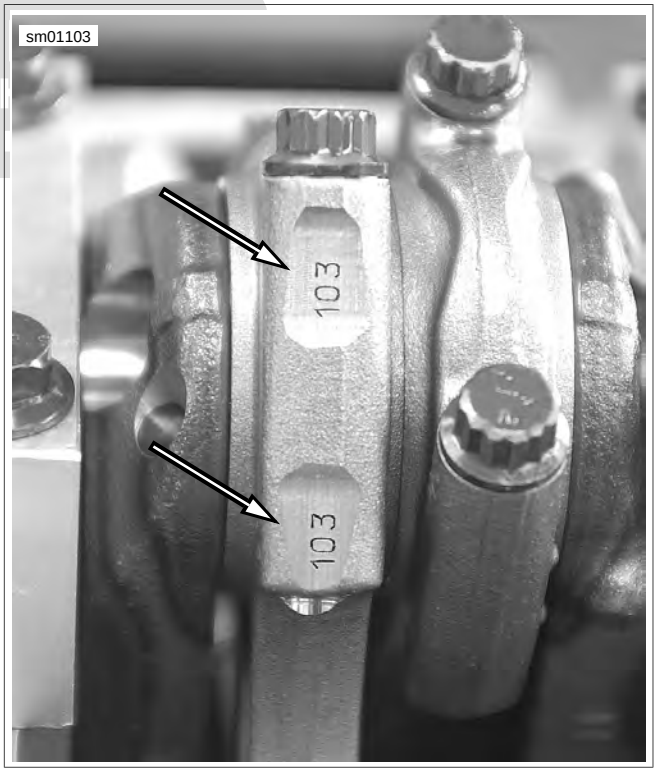


Figure 3-99. Match Rod and Cap

3. See Figure 3-99. Note the numbers on connecting rod and cap. Connecting rods and caps must be used in matched sets.

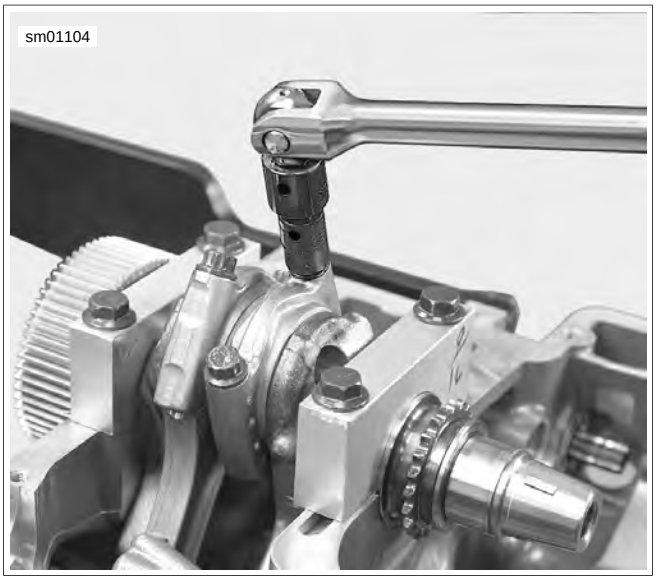


Figure 3-100. Loosen Rod Cap Fasteners

4. See Figure 3-100. Loosen connecting rod caps fasteners.
5. Remove the crankshaft assembly retainers.

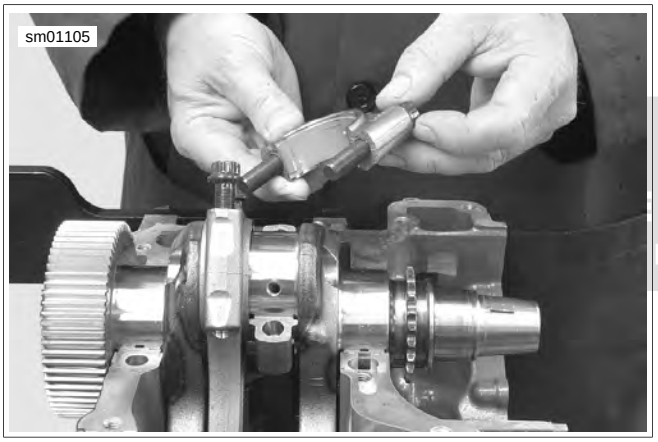


Figure 3-101. Remove Rod Caps

6. See Figure 3-101. Inspect connecting rod bearing shells. Look for scoring or discoloration.

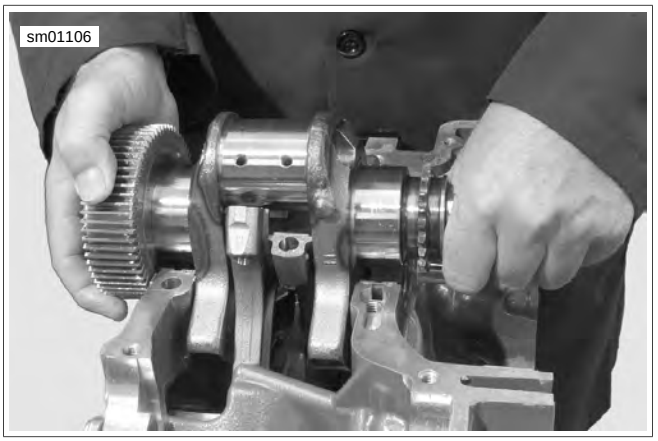


Figure 3-102. Remove Crankshaft

7. See Figure 3-102. Remove crankshaft.

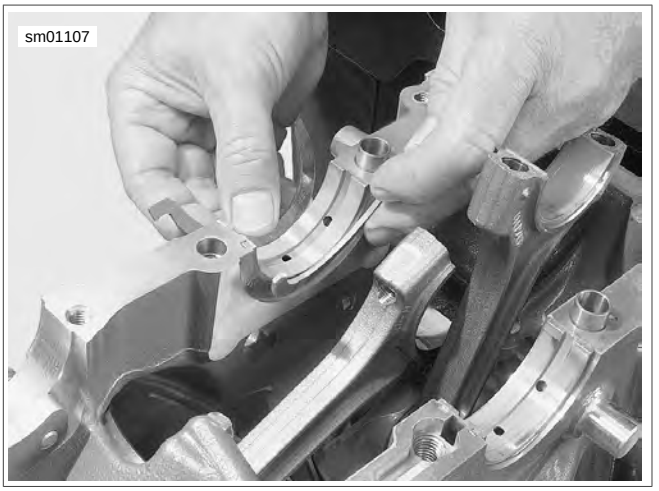


Figure 3-103. Remove Main Bearing Retainers

8. See Figure 3-103. Remove crankshaft thrust bearings.

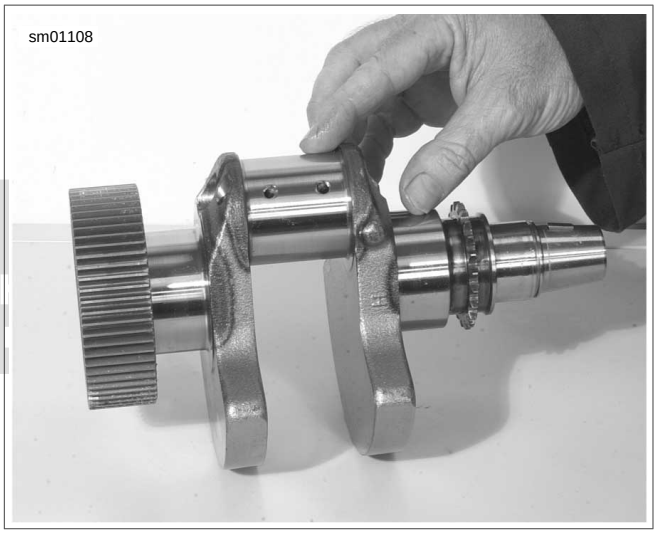


Figure 3-104. Inspect Crankshaft

9. See Figure 3-104. Check journals for scoring, bluing and surface damage. Check main drive gear for wear or missing teeth.

NOTE

Mild bluing around crankshaft journal and sprocket edges is due to heat treating process and is normal. However, metal transfer and bluing on journal surface indicates damage and crankshaft must be replaced.

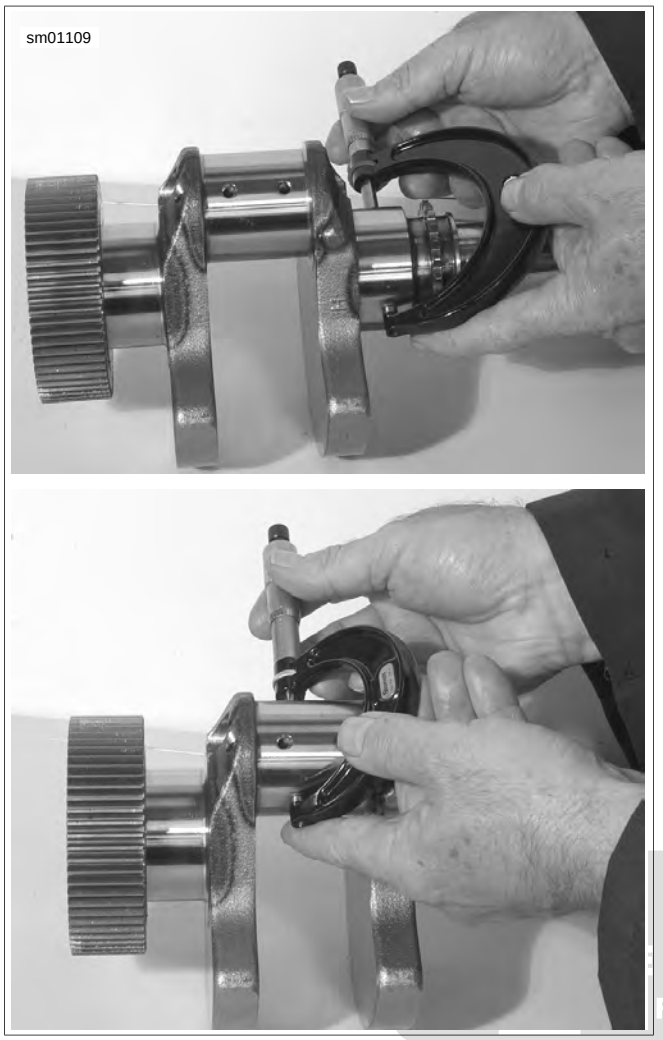


Figure 3-105. Measure Journal

10. See Figure 3-105. Measure bearing journals. For bearing selection, refer to Table 3-12 and Table 3-13 for specifications.

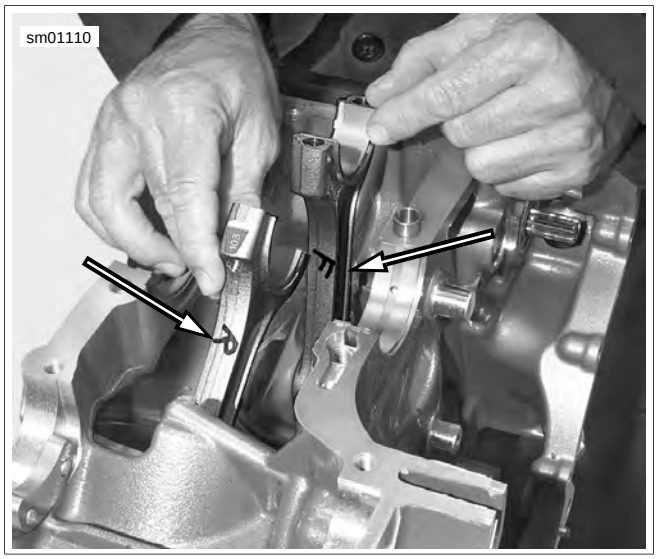


Figure 3-106. Mark Connecting Rods

11. See Figure 3-106. If rods are to be reused, mark them F (front) and R (rear). Rod must be installed in the same position.

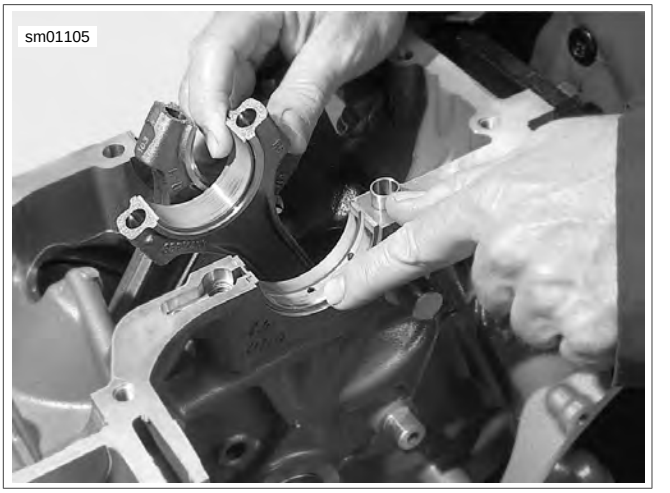


Figure 3-107. Bearing Shells

12. See Figure 3-107. Inspect bearing shells for scoring or discoloration.

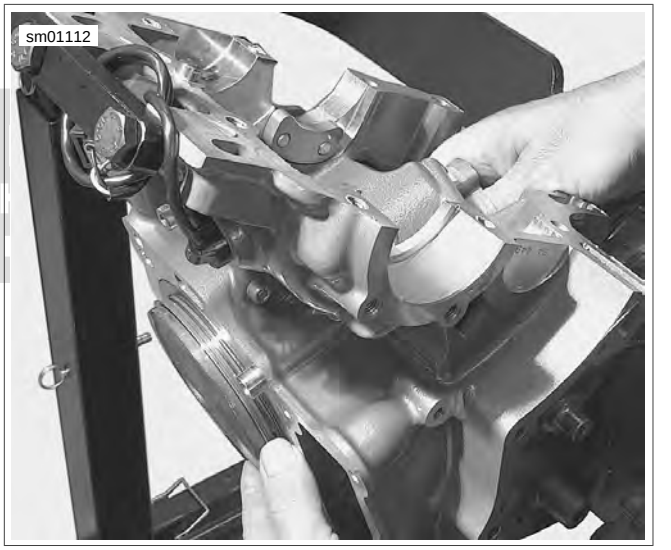


Figure 3-108. Remove Pistons

13. See Figure 3-108. Carefully push piston and rod out top of cylinder. Avoid contacting piston jet. Do not let the connecting rod contact the cylinder liner wall.



Figure 3-109. Wrist Pin Retaining Rings

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

NOTE

*Do not separate pistons from rods unless they will be replaced with **new** parts.*

14. See Figure 3-109. Remove and discard wrist pin retaining rings using PISTON PIN REMOVAL AND INSTALLATION TOOL (Part No. HD-47189).



Figure 3-110. Install Rod Caps for Inspection

15. Remove and discard rod bearing shells.
16. See Figure 3-110. Note rod and cap identifying numbers and casting bumps. Install rod caps and tighten to 27 Nm (20 ft-lbs) plus an additional 90 degrees using TORQUE ANGLE GAUGE (Part No. Snap-on TA360).
17. See Figure 3-111. Measure big end bore with a dial bore gauge. Measurement must be between 51.616 mm (2.032 in.)-51.60 mm (2.031 in.).
18. See Figure 3-112. Inspect small end bushing and wrist pin fit. The running clearance should be between 0.033 mm (0.001 in.)-0.018 mm (0.0007 in.).



Figure 3-111. Measure Big End

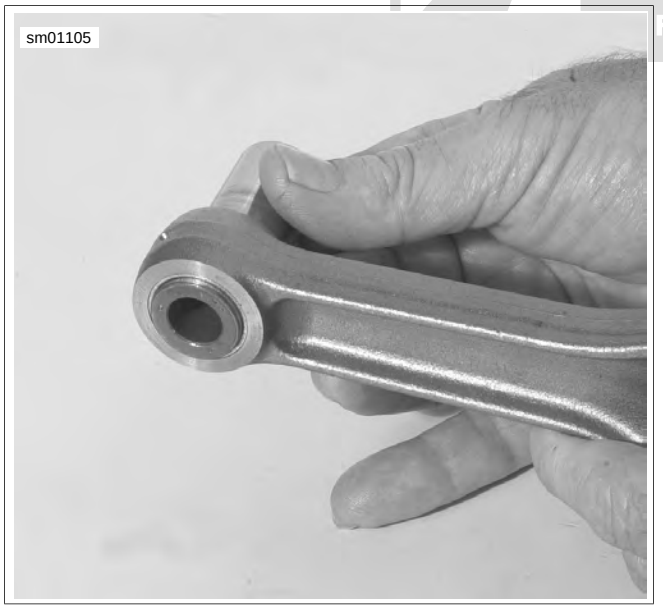


Figure 3-112. Inspect Small End

19. See Figure 3-113. Measure piston diameter on thrust surface.



Figure 3-113. Piston Measurement

20. See Figure 3-114. FLYWHEEL SUPPORT FIXTURE (Part No. HD-44358) can be modified to hold crankshaft when removing or installing primary drive gear. Open bore of center hole to 59.7 mm (2.350 in.).
21. See Figure 3-115. Remove and discard primary drive gear fasteners.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

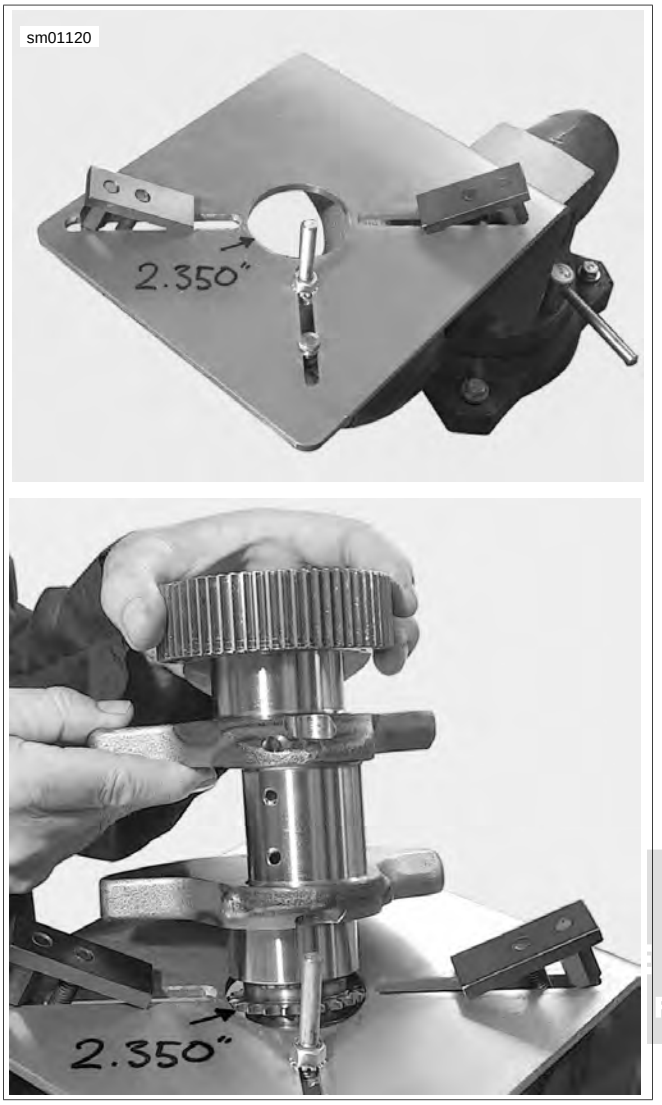


Figure 3-114. Flywheel Support Fixture

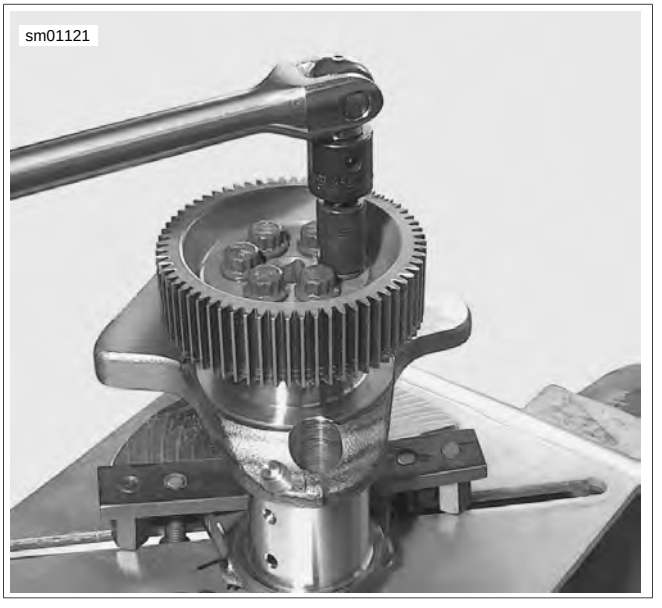


Figure 3-115. Remove Primary Gear

22. See Figure 3-116. Examine primary drive gear. Inspect thrust surfaces for excessive wear or chipping. Note the timing marks on the primary drive gear and the crankshaft. Assemble with the timing mark on the drive gear over the timing mark on the crankshaft.
23. See Figure 3-117. Lubricate **new** primary drive gear fasteners with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. Lubricate threads and under head of bolt.
24. See Figure 3-118. Using a crisscross pattern, tighten the primary gear fasteners to 15 Nm (132 **in-lbs**) plus an additional 60 degrees using TORQUE ANGLE GAUGE (Part No. Snap-on TA360).



Figure 3-116. Primary Gear Timing Marks



Figure 3-117. Installing Primary Gear

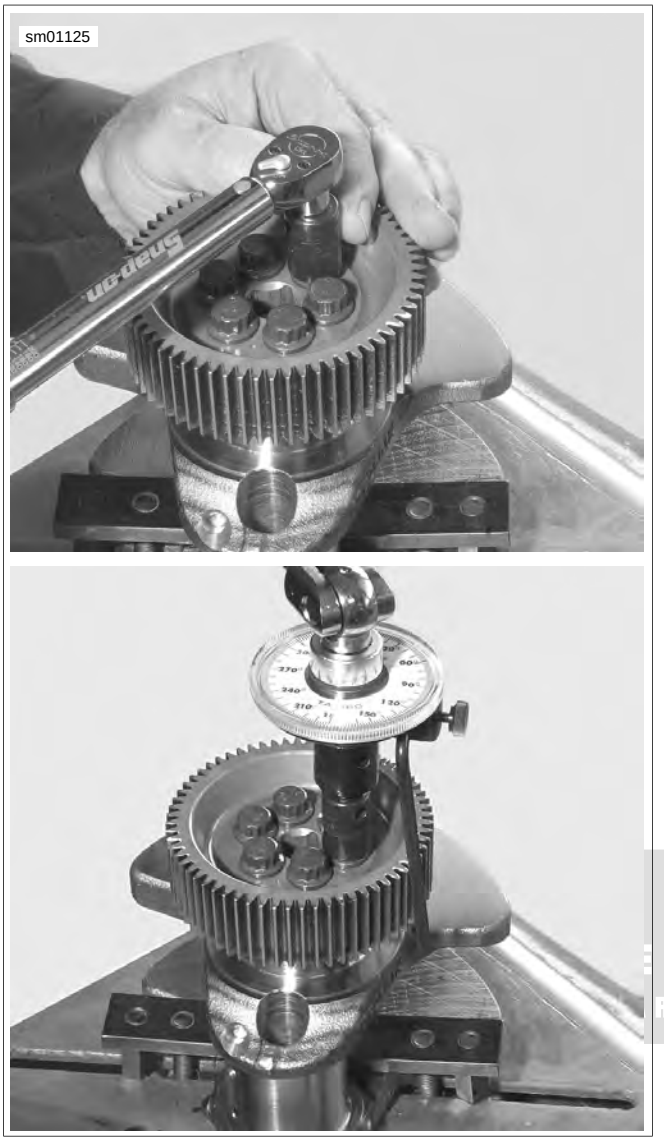


Figure 3-118. Tighten Primary Gear



Figure 3-119. Measure Cylinder Bore

25. See Figure 3-119. Using a dial bore gauge, check cylinder concentricity. See specifications for serviceability.

NOTE

If cylinder liner is to be removed, mark liner and crankcase so the liner can be installed in the same position. Pick a convenient feature for reference.

26. See Figure 3-120. Mark case and cylinder liner and install CYLINDER LINER REMOVER/INSTALLER (Part No. HD-45313).

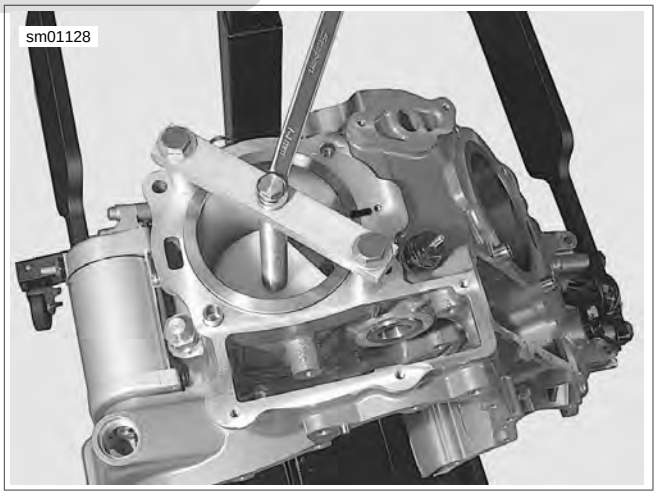


Figure 3-120. Mark Case and Cylinder Liner and Install Cylinder Liner Remover/Installer

27. See Figure 3-121. According to instruction sheet for cylinder liner remover/installer, remove liner.

28. See Figure 3-122. Inspect piston jet. Piston jet must fit tight and have no visible damage. If loose or damaged, crankcase must be replaced.

29. See Figure 3-123. Carefully clean cylinder liner and step in crankcase. Debris in the step could prevent the cylinder liner from fully seating.



Figure 3-121. Remove Cylinder Liner

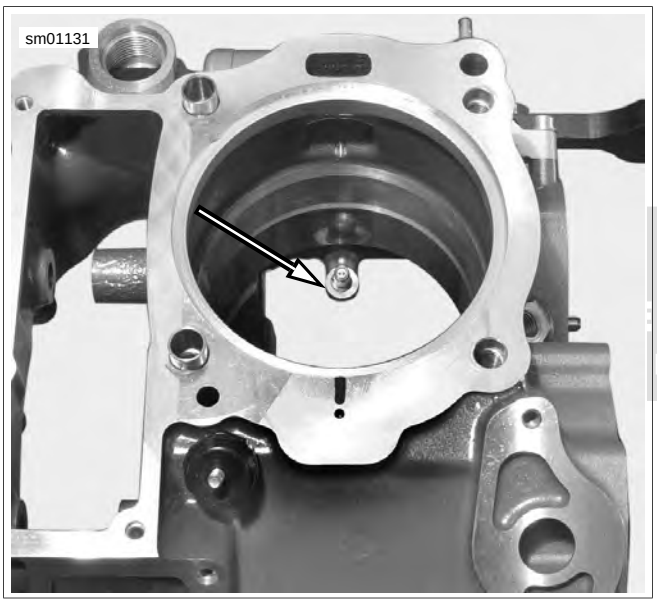


Figure 3-122. Piston Jet

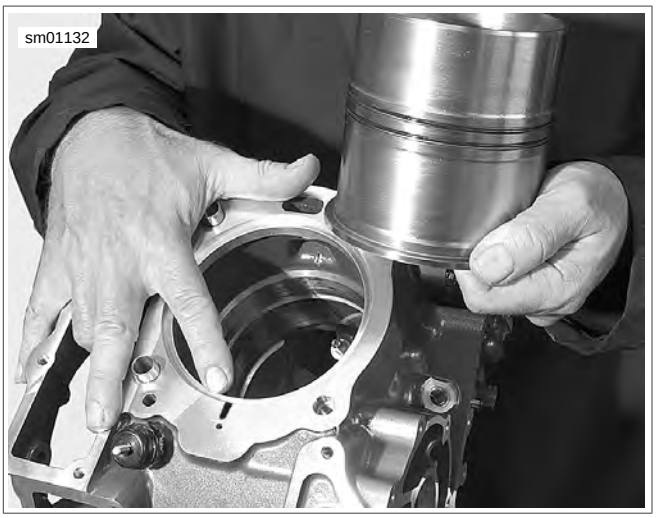


Figure 3-123. Clean Liner and Case Step



Figure 3-124. Lubricate Liner

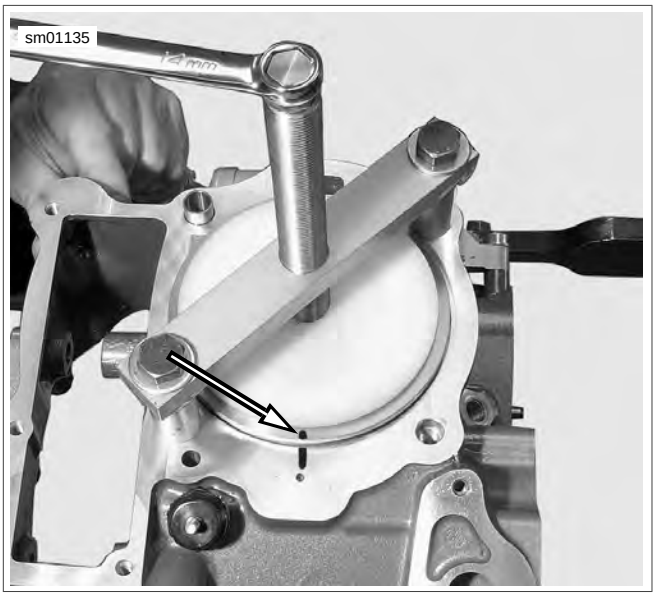


Figure 3-125. Align Case and Cylinder Marks and Insert Liner

30. See Figure 3-124. Lubricate **new** O-rings with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 to keep O-rings seated on cylinder.
31. See Figure 3-125. Align case and cylinder marks and insert liner in the case bore. Install CYLINDER LINER REMOVER/INSTALLER according to instruction sheet and install liner.
32. See Figure 3-127. Check ring end gap by placing ring in cylinder and measure gap using feeler gauges. See specifications for serviceability.
33. See Figure 3-128. Carefully install piston rings. Second compression ring is installed with the mark to the top. When ring set is installed, gaps must be staggered.

NOTE

If engine is to be assembled at this point, make sure all parts are cleaned and lubricated appropriately.

34. See Figure 3-126. Looking at top of piston, place connecting rod in piston with bumps on rod to the right and EX mark right side up.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

35. See Figure 3-129. Install wrist pin and wrist pin retaining rings using PISTON PIN REMOVAL AND INSTALLATION TOOL (Part No. HD-47189).

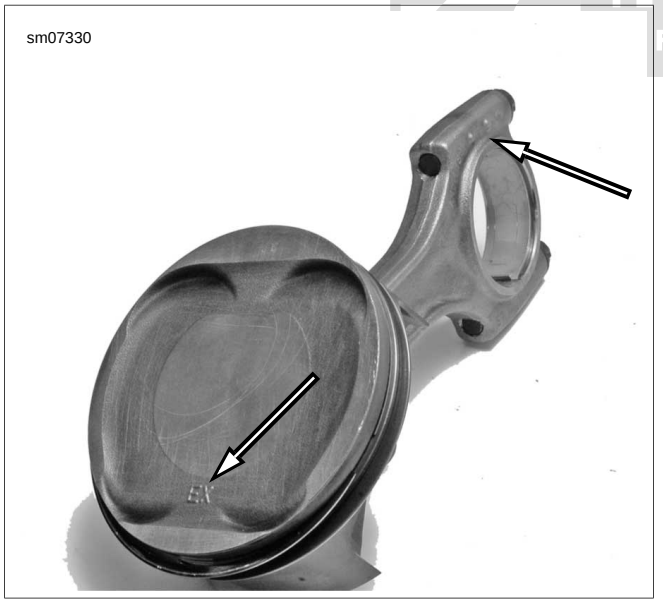


Figure 3-126. Piston/Rod Orientation

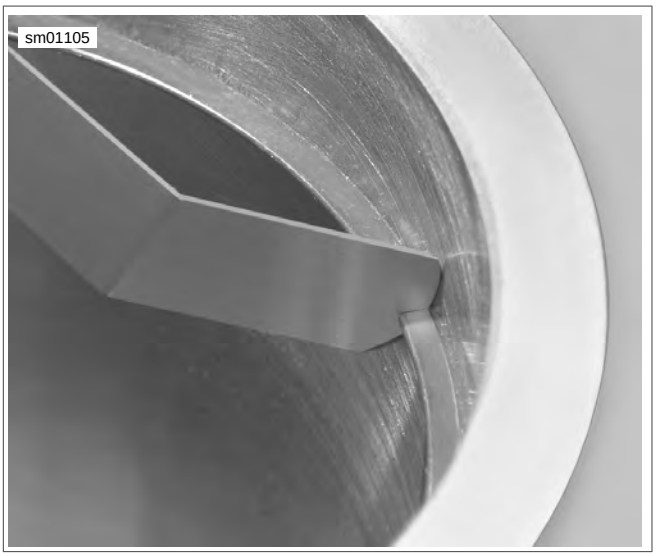


Figure 3-127. Ring End Gap

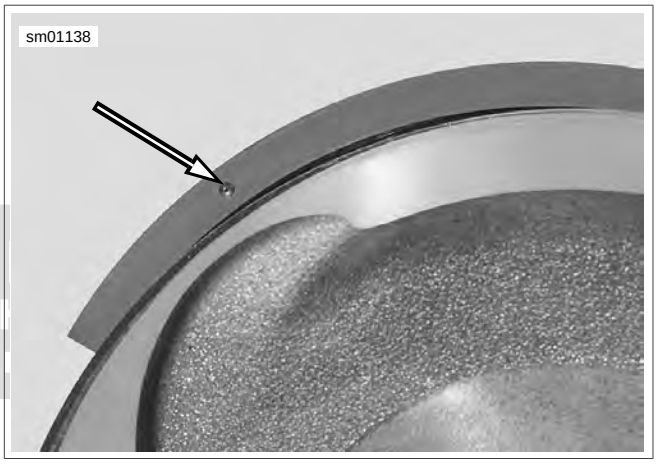


Figure 3-128. Second Compression Ring Top Mark



Figure 3-129. Wrist Pin Retaining Rings

36. See Figure 3-131. To install piston, complete each of the following steps:
 a. Lightly lubricate inside of PISTON RING COMPRESSOR (Part No. HD-96333-105) piston rings and piston skirt with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50.
 b. See Figure 3-130. Place ring compressor on piston with arrow toward the connecting rod.

NOTE

Failure to orient pistons correctly will result in engine failure. Verify EX mark on top of piston is facing the exhaust port side of the cylinder and alignment bumps on connecting rod facing toward the outside of crankcase.

 c. Verify orientation and slide piston and connecting rod into cylinder.

NOTE

Correct piston and connecting rod orientation is as follows:

 d. See Figure 3-126. Front piston EX mark on exhaust side of bore and connecting rod alignment bumps to cam drive side of engine
 e. Rear piston EX mark on exhaust side of bore and connecting rod alignment bumps to water pump side of engine
 f. Squeeze handle to compress rings but still allow piston and rings to slip through compressor into cylinder bore.

NOTES

See Figure 3-122. With free hand inside crankcase, guide rod past piston jet. If piston jet is damaged, crankcase must be replaced.

If excess resistance is encountered, stop and examine components. A ring can gouge the cylinder wall if forced.

 g. See Figure 3-131. Using a rubber or wooden mallet handle, gently tap piston into bore. Hold constant pressure on the piston ring compressor until rings have entered bore.
 h. When piston and rings are in the bore, move piston up and down the bore to verify rings have not become inoperative during installation.



Figure 3-130. Piston Ring Compressor

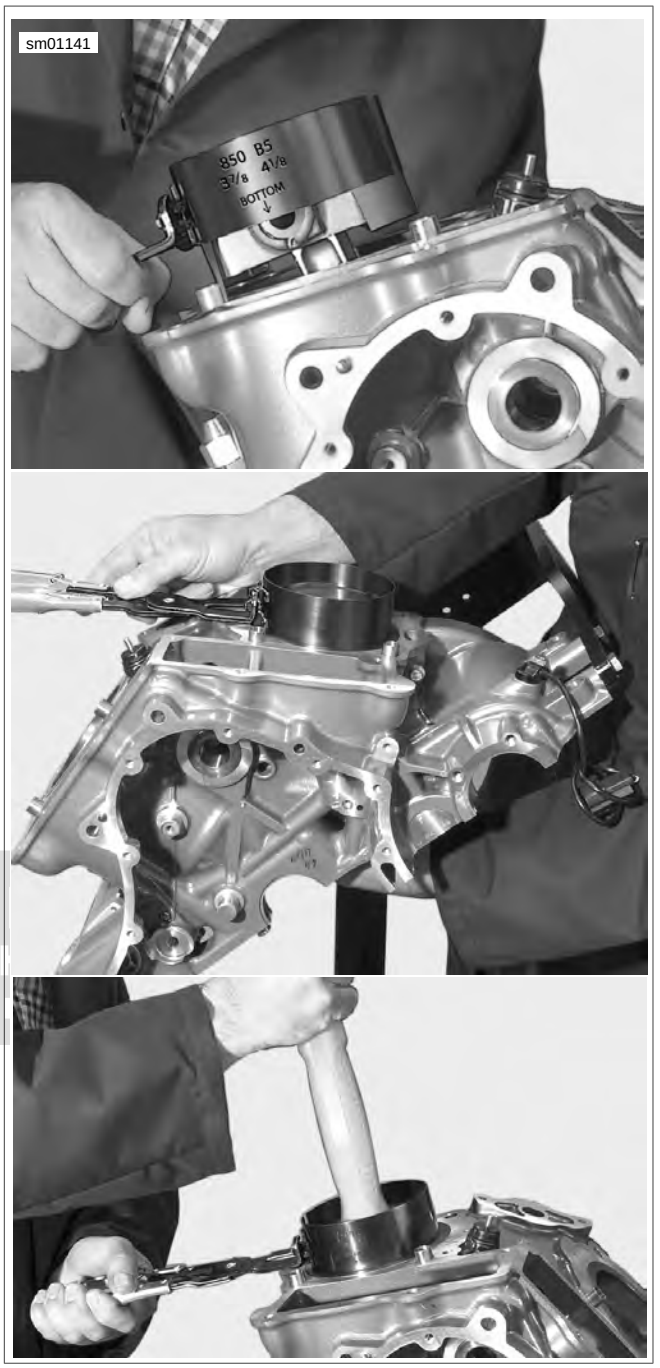


Figure 3-131. Insert Piston

37. Clean connecting rod and cap bore making sure they are free of oil.
38. See Figure 3-135. Select rod bearing replacement set to match rod bearing journal diameter color code (3) on crankshaft. Refer to Table 3-24.

NOTES

- *Rod bearing sets (front and rear) are available in two sizes, coded red (R) and blue (B). The rod bearing color code appears on the bearing shell edge.*
- *Always measure bearing journals before selecting and installing bearings.*

Table 3-24. Rod Bearing Journal Diameter

COLOR CODE	H-D PART NO.	SPECIFICATION	
Red	24412-01K	Max	47.991 mm
		Min	47.983 mm
Blue	24413-01K	Max	47.983 mm
		Min	47.975 mm

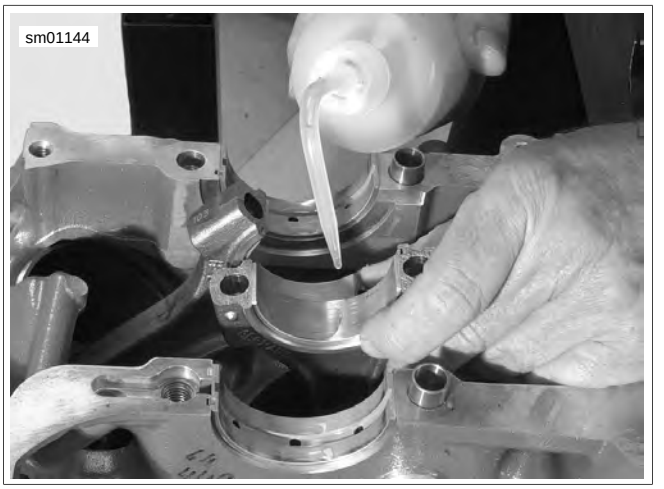


Figure 3-132. Lubricate Bearings

39. See Figure 3-132. Install rod bearings and lubricate bearing surface with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE is recommended.



Figure 3-133. Install Thrust Bearing

40. See Figure 3-133. Install thrust bearing. Use a small amount of grease to hold in position.

41. See Figure 3-134. Move connecting rods so front connecting rod points to rear, and rear rod points to front of engine.

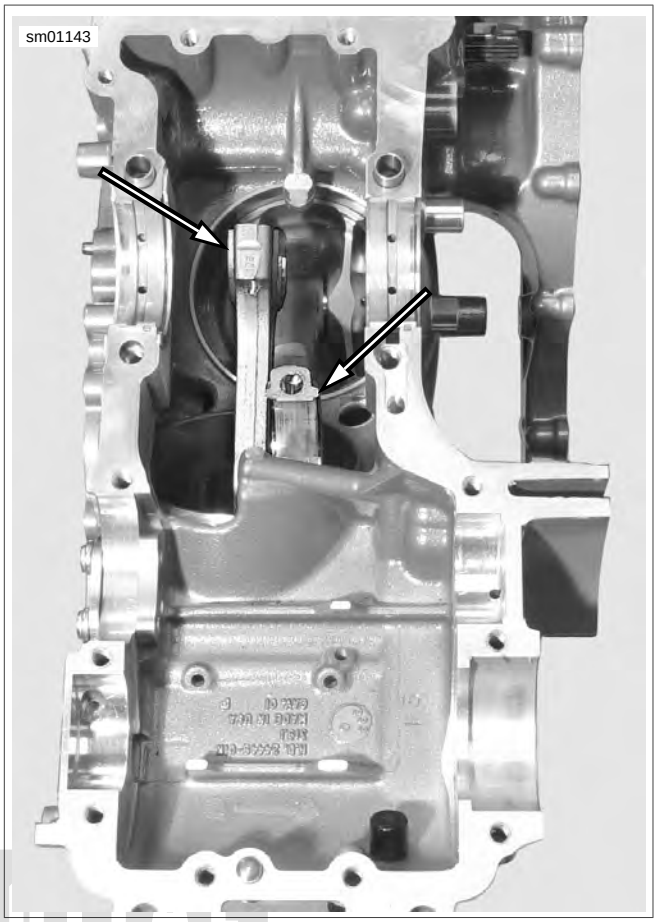
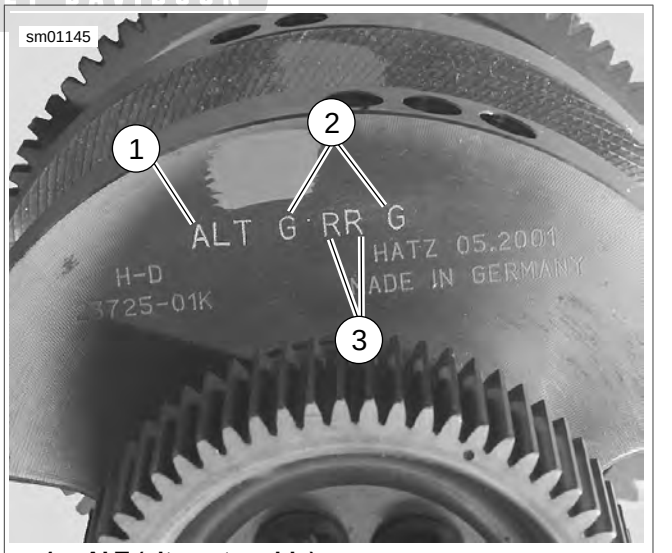


Figure 3-134. Position Connecting Rods



1. **ALT (alternator side)**
2. **G (green main bearing code)**
3. **R (red rod bearing code)**

Figure 3-135. Crankshaft Color Code

42. See Figure 3-135. Crankshaft counter weight is stamped with the original color code for main bearing and rod journal replacement sets. Read from left to right, the letter code corresponds to the alternator and clutch side main

bearing journals (2) and the front rod and rear rod journals (3).

43. Refer to Table 3-25. Select main bearing set corresponding to color code on crankshaft.

NOTE

Always measure bearing journals before selecting and installing bearings.

Table 3-25. Main Bearing Journal Diameter

COLOR CODE	H-D PART NO.		ALTERN-ATOR SIDE	CLUTCH SIDE
Blue	24411-01K	Max	55.977 mm	55.952 mm
		Min	55.971 mm	55.946 mm
Green	24410-01K	Max	55.984 mm	55.959 mm
		Min	55.977 mm	55.952 mm
Red	24409-01K	Max	55.990 mm	55.965 mm
		Min	55.984 mm	55.959 mm

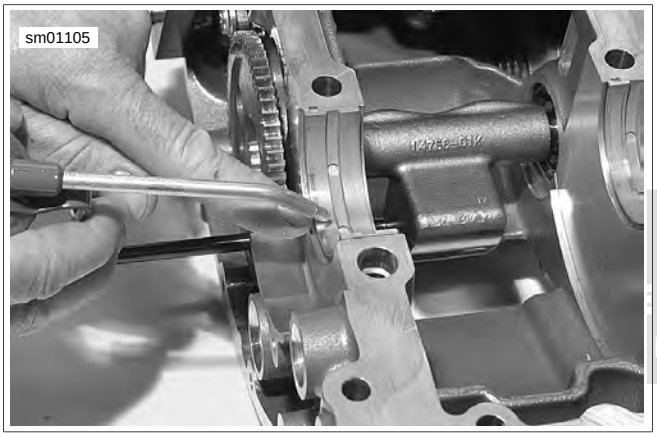


Figure 3-136. Lubricate Crankshaft Bearings

44. See Figure 3-136. Install main bearings and lubricate bearing surface with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE is recommended.

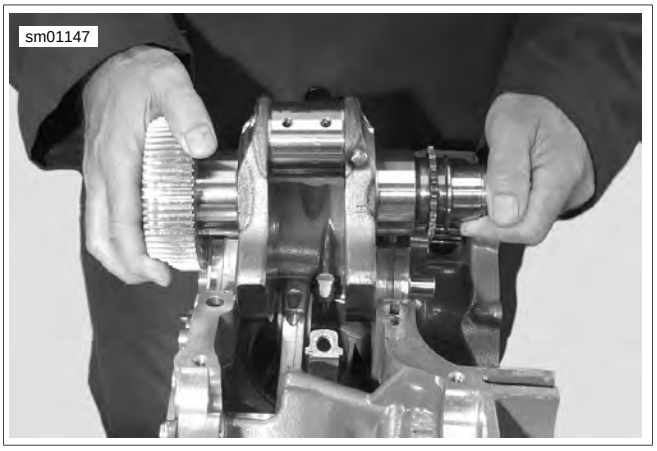


Figure 3-137. Install Crankshaft

45. See Figure 3-137. Carefully position crankshaft.
46. See Figure 3-97. Install CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316).

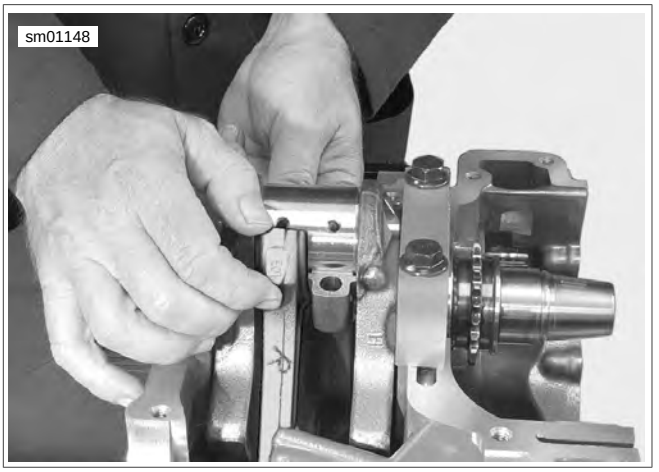


Figure 3-138. Position Connecting Rods

47. See Figure 3-139. Lubricate crankshaft journal and connecting rod bearings with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. In addition, a thin film of SCREAMIN' EAGLE ASSEMBLY LUBE is recommended.
48. See Figure 3-138. Pull piston and rod assembly up to crankshaft journal.
49. See Figure 3-140. Install connecting rod caps. Confirm connecting rods and caps have identical numbers and cast bumps are oriented correctly.
50. Apply a light coat of clean engine oil on the threads and under the bolt head and install connecting rod bolts.

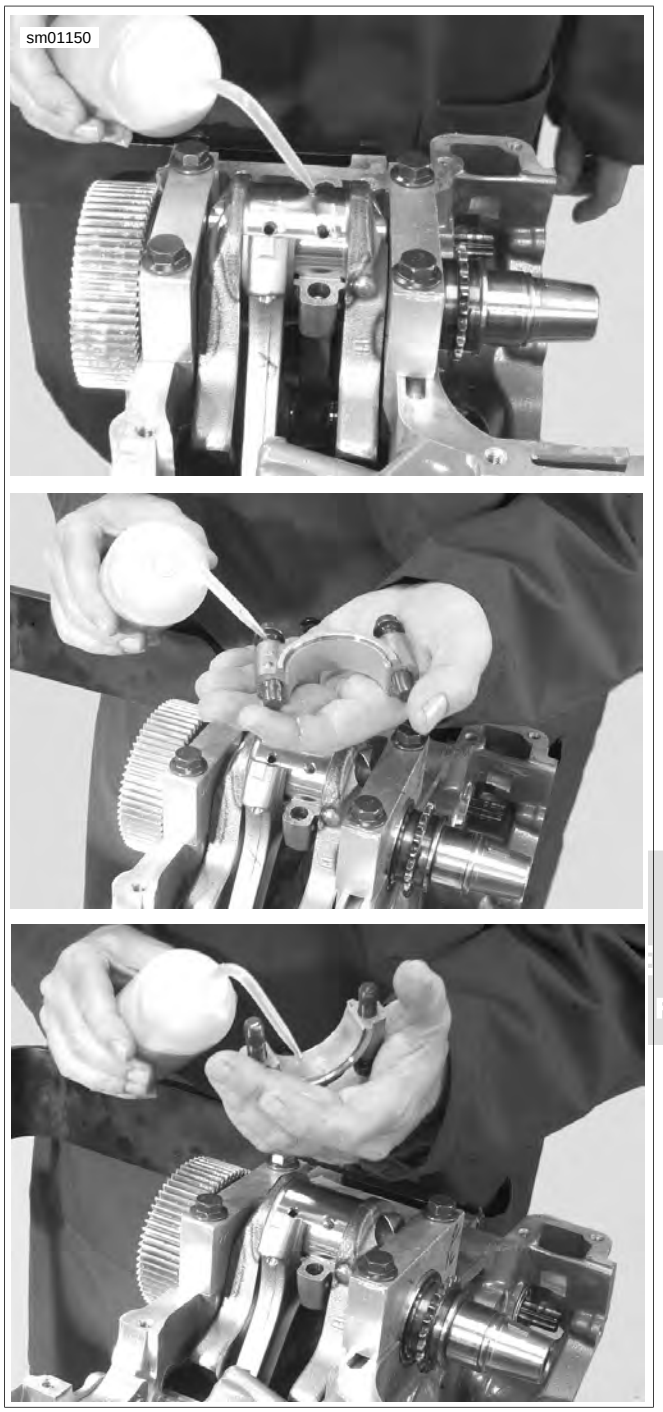


Figure 3-139. Lubricate Crankshaft and Rods

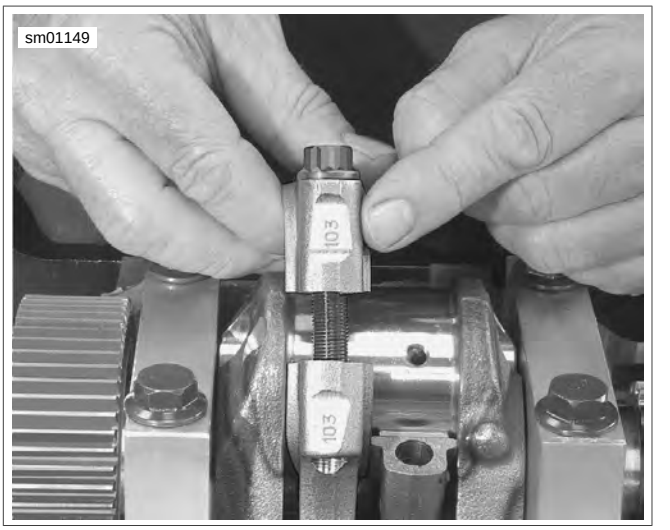


Figure 3-140. Install Connecting Rod Caps



Figure 3-141. Install Connecting Rod Caps

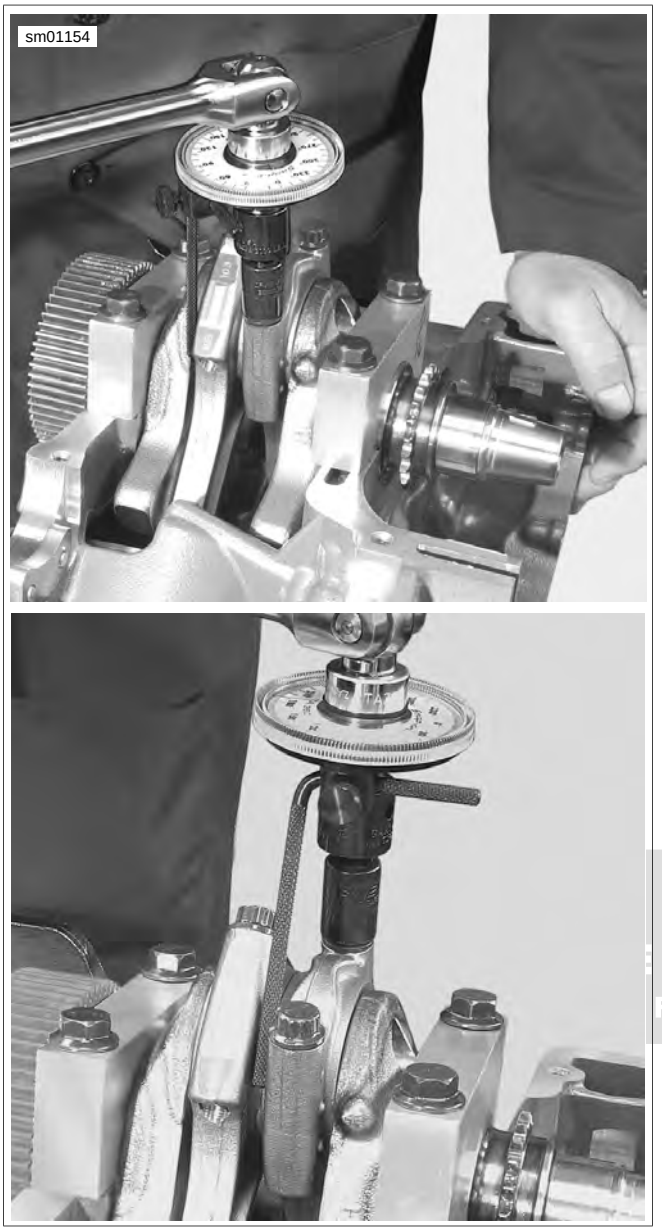


Figure 3-142. Tighten Connecting Rod Caps

51. See Figure 3-141. Tighten connecting rod bolts to 27 Nm (20 ft-lbs).
52. See Figure 3-142. Tighten connecting rod bolts an additional 90 degrees using TORQUE ANGLE GAUGE (Part No. Snap-on TA360).

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

53. Rotate crankshaft to locate front piston at TDC.
54. Assemble case halves. See 6.4 TRANSMISSION, Assembly.

NOTE

To continue engine overhaul, proceed to 3.10 CYLINDER HEAD, Installation.

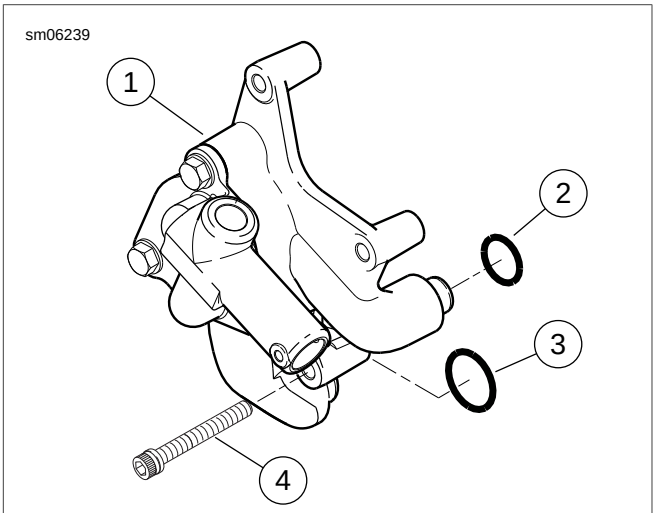
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OIL PUMP 3.13

REMOVAL/INSTALLATION

FASTENER	TORQUE VALUE	
Oil pump fasteners	9.7 Nm	86 **in-lbs**

1. Remove clutch cover. See 6.3 CLUTCH.
2. See Figure 3-143. Remove three fasteners (4) holding oil pump (1) to case.
3. Pull pump straight out to remove from engine.
4. Remove O-rings (2, 3).
5. Thoroughly lubricate internal pump components with SCREAMIN' EAGLE ASSEMBLY LUBE prior to installation.
6. See Figure 3-143. Install **new** O-rings (2, 3) and lubricate with SCREAMIN' EAGLE ASSEMBLY LUBE.
7. Install pump and tighten three fasteners (4) to 9.7 Nm (86 **in-lbs**).
8. Install clutch cover. See 6.3 CLUTCH.



1. **Oil pump assembly**
2. **O-ring**
3. **O-ring**
4. **Fastener (3)**

Figure 3-143. Oil Pump

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

OIL FILTER MOUNT 3.14

REMOVAL/INSTALLATION

FASTENER	TORQUE VALUE	
Oil filter mount fasteners	9.7 Nm	86 **in-lbs**

1. See Figure 3-144. Remove three fasteners and remove oil filter mount.
2. See Figure 3-145. Remove O-ring and discard.
3. Inspect oil passages for debris and dirt. Clean as required.
4. Install **new** O-ring and install oil filter mount.

NOTE

Always replace O-ring when oil filter mount has been removed and/or replaced.

5. Tighten oil filter mount fasteners to 9.7 Nm (86 **in-lbs**).

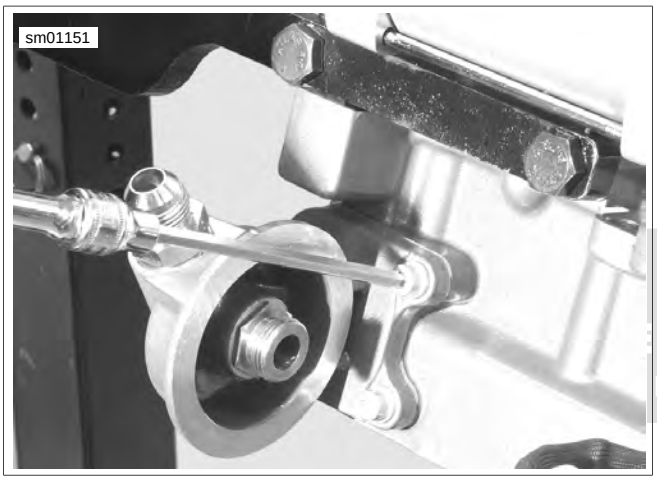


Figure 3-144. Remove Oil Filter Mount Fasteners

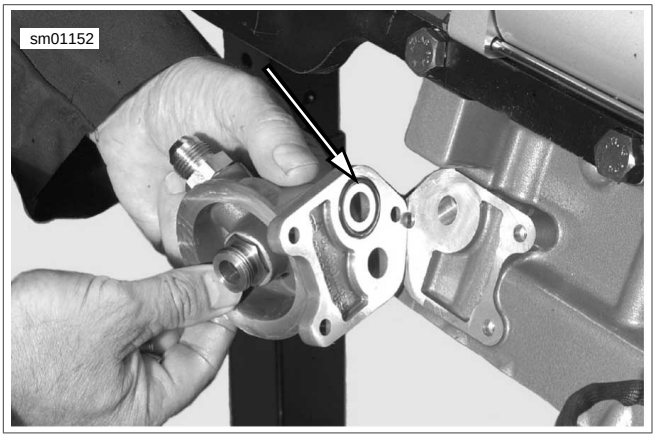


Figure 3-145. Replace O-Ring

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NOTES

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

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DIGITAL TECHNICIAN® II HARLEY-DAVIDSON®

NOTES

FASTENER TORQUE VALUES 4.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Auxiliary volume screws	23 Nm	17 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Crossover TORCA clamp	13-15 Nm	115-133 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Cylinder head exhaust flange nuts, front	8-12 Nm	71-106 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Cylinder head exhaust flange nuts, rear	8-12 Nm	71-106 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Drive sprocket cover screws	6-10 Nm	53-88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Exhaust bracket stud plate fasteners	19-27 Nm	14-20 ft-lbs	4.15 EXHAUST SYSTEM: VRSCF, Installation
Exhaust flange nuts	8-12 Nm	71-106 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel rail bolts	9.7 Nm	86 **in-lbs**	4.5 THROTTLE BODY AND FUEL RAIL, Installation
Fuel tank mounting fasteners	40-48 Nm	30-35 ft-lbs	4.10 FUEL TANK, Installation
Heat shield screws	10 Nm	88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
IAC screws	2-4 Nm	25-35 **in-lbs**	4.6 IDLE AIR CONTROL (IAC), Installation
Intake hose clamps	1.25 Nm	11 **in-lbs**	4.5 THROTTLE BODY AND FUEL RAIL, Installation
Lower muffler clamp	65 Nm	48 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Lower muffler screws	23 Nm	17 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
MAP sensor bracket bolt	6.0-10.0 Nm	53-88 **in-lbs**	4.7 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP), Installation
Muffler heat shield fasteners	2.3-4.5 Nm	20-40 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Muffler inlet endcap screws	0.6 to 1.2 Nm	5.3 to 10.6 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Muffler outlet endcap screws	1.7 to 2.3 Nm	15.0 to 20.3 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Muffler TORCA clamps	52-58 Nm	38-43 ft-lbs	4.15 EXHAUST SYSTEM: VRSCF, Installation
Oxygen sensor	16.5-19.5 Nm	12-14 ft-lbs	4.8 OXYGEN SENSOR, Installation
Oxygen sensor bracket nut	8-10 Nm	71-88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Oxygen sensor heat shield bracket	8-12 Nm	71-106 **in-lbs**	4.8 OXYGEN SENSOR, Installation
Rear exhaust pipe to auxiliary volume clamp	13-17 Nm	115-150 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Top plate fasteners	5-6 Nm	44-53 **in-lbs**	4.11 FUEL MODULE ASSEMBLY, Installation
TP sensor screws	2.0-2.8 Nm	18-25 **in-lbs**	4.3 THROTTLE POSITION SENSOR (TP), Installation
Upper muffler clamp	65 Nm	48 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Upper muffler screws	23 Nm	17 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

SPECIFICATIONS: FUEL SYSTEM 4.2

GENERAL

Table 4-1. Capacities: VRSC Models

COMPONENT	METRIC	ENGLISH
Fuel tank total	18.9 liters	5.0 gal
Oil sump with filter	4.7 liters	5.0 qt
Coolant	2.4 liters	2.54 qt
All VRSC models are shipped with Genuine Harley-Davidson SAE 20W50 Motorcycle oil.		

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

THROTTLE POSITION SENSOR (TP) 4.3

GENERAL

See the electrical diagnostic manual for information on the function and testing of the throttle position sensor (TPS).

REMOVAL

1. Remove air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

2. See Figure 4-1. Cover air intakes (3) to prevent debris from entering cylinders.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Remove main fuse.
4. Unplug TP sensor connector [88B] (2) by pulling external latch outward and using rocking motion to remove.
5. Remove two screws to detach TP sensor (1) from throttle body. Discard screws.

INSTALLATION

FASTENER	TORQUE VALUE	
TP sensor screws	2.0-2.8 Nm	18-25 **in-lbs**

NOTES

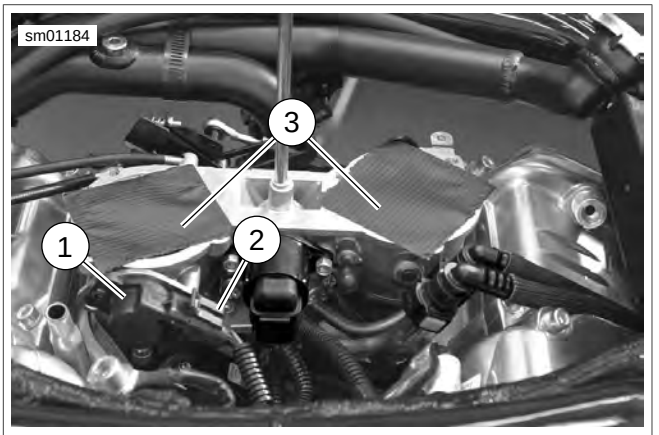
- *Throttle must be closed for proper installation of throttle position sensor.*
- *Throttle position sensor does not have to be adjusted.*

1. See Figure 4-2. With connector facing rear of vehicle, verify that shaft pocket of TP sensor fits over shaft on throttle body.
2. Align holes in TP sensor with holes in throttle body.

NOTE

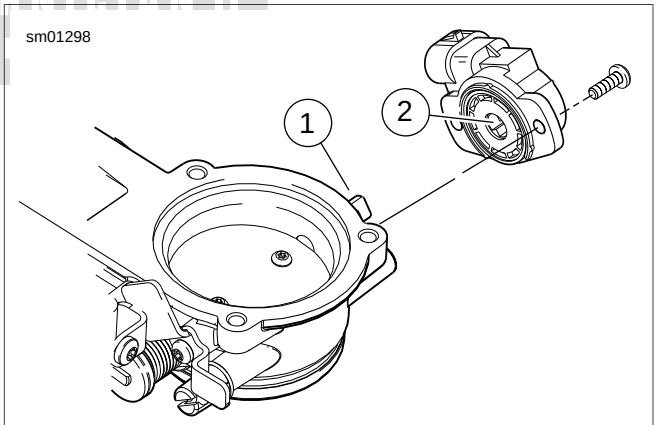
TP sensor may have to be turned slightly for holes to align.

3. Install **new** screws and tighten to 2.0-2.8 Nm (18-25 **in-lbs**).
4. See Figure 4-1. Connect TP sensor connector (2).
5. Install main fuse.
6. Install air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Throttle position sensor (TP sensor)**
2. **TP sensor connector [88B]**
3. **Air intakes (covered)**

Figure 4-1. Throttle Position Sensor



1. **Shaft**
2. **Shaft pocket**

Figure 4-2. Throttle Position Sensor Installation

INTAKE AIR TEMPERATURE SENSOR (IAT) 4.4

GENERAL

See the electrical diagnostic manual for information on the function and testing of the intake air temperature sensor (IAT sensor).

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.
2. Remove air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
3. See Figure 4-3. Remove IAT sensor connector [89B].
 a. See Figure 4-4. Depress wire form.
 b. Use rocking motion to detach connector from IAT.
4. See Figure 4-5. Depress the retaining fingers (2) on the under side of IAT sensor and pull IAT sensor from upper air box.

NOTE

A short length of tubing with an ID of 7.62 mm (0.312 in) can be pushed over the retaining fingers to ease the sensor removal.

INSTALLATION

1. See Figure 4-5. Inspect IAT O-ring (1). Replace IAT sensor if O-ring is worn or damaged.
2. Apply **clean** engine oil to IAT sensor O-ring.
3. Install IAT sensor into upper air box.
4. Connect IAT sensor connector [89B].
5. Install air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
6. Install main fuse.
7. Install right side cover.

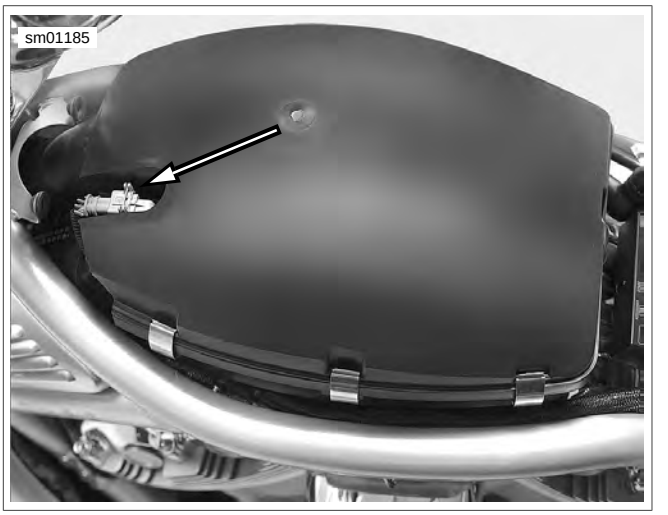


Figure 4-3. Intake Air Temperature Sensor Location (typical)

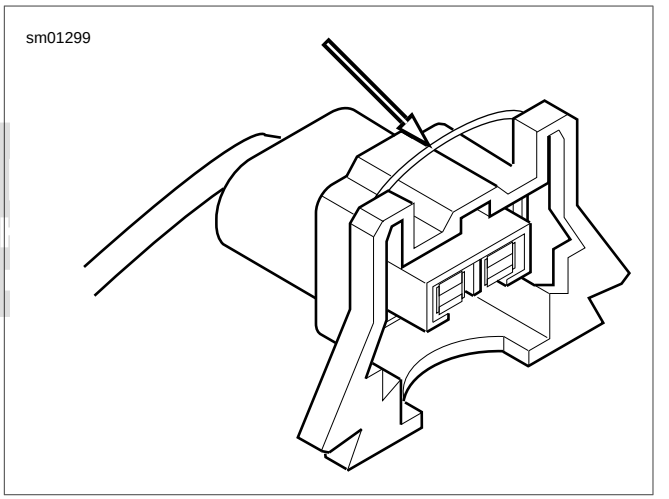
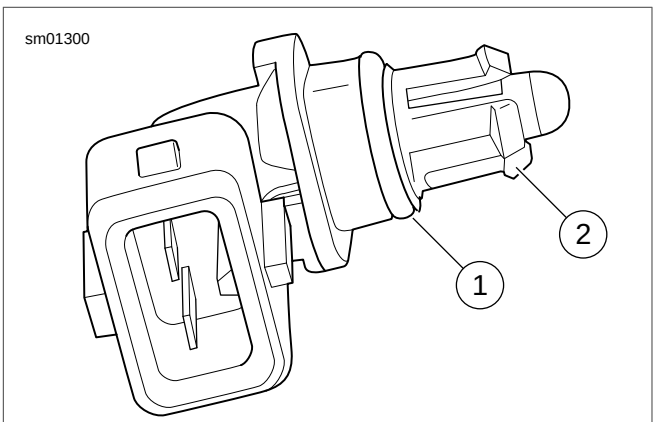


Figure 4-4. IAT Connector Wire Form



1. **O-ring**
2. **Retaining fingers**

Figure 4-5. IAT Sensor

THROTTLE BODY AND FUEL RAIL 4.5

REMOVAL

1. Purge fuel supply line of high pressure gasoline.
 a. Disconnect fuel pump connector [86B] from fuel module assembly.
 b. Start engine and allow vehicle to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove main fuse. See 7.6 MAIN FUSE.
3. Remove air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
4. Disconnect the IAC connector [87].
5. Disconnect the TP sensor connector [88].
6. Loosen throttle body intake hose clamps.
7. Detach throttle body from rubber seals by pulling up with a gentle rocking motion. If throttle body replacement is not required, do not disconnect throttle cables. Secure throttle body and cables away from engine.
8. Disconnect fuel lines.
9. See Figure 4-6. Remove fuel rail/intake seal fasteners. Bottom nut is captured but should be held with a wrench for removal.
10. See Figure 4-7. Without disturbing the fuel rail, rotate rubber seal from under fuel rail.
11. Remove fastener holding the MAP sensor. Separate connector [80].
12. See Figure 4-9. Pull front injector from front intake runner.
13. Swing fuel rail toward cam drive side and pull rear injector from rear intake runner.
14. See Figure 4-8. Unplug connector [84], front injector and connector [85], rear injector.
15. Disassemble and service fuel rail and fuel injectors as necessary. See 4.9 FUEL INJECTORS.



Figure 4-6. Fuel Rail/intake Seal Fasteners (typical)



Figure 4-7. Rubber Seal

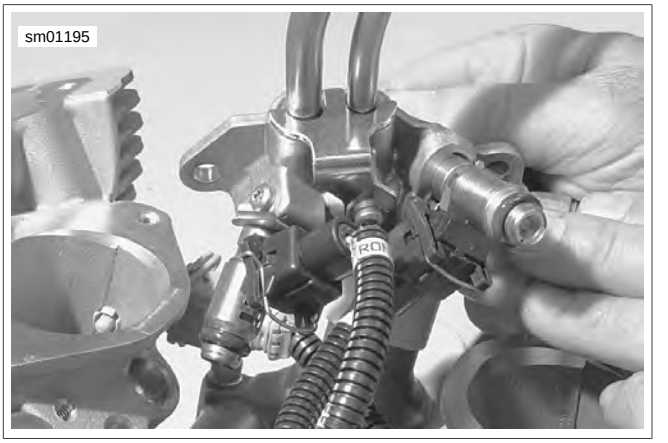


Figure 4-8. Fuel Rail with Injectors

INSTALLATION

FASTENER	TORQUE VALUE	
Fuel rail bolts	9.7 Nm	86 **in-lbs**
Intake hose clamps	1.25 Nm	11 **in-lbs**

1. Assemble fuel rail.
2. Install fuel injectors. See 4.9 FUEL INJECTORS.

3. Connect front [84] and rear [85] fuel injector connectors.
4. Supporting fuel rail oriented with fuel tubes toward the left rear, push rear injector into bore in intake runner.
5. Swing fuel rail over and push front injector into intake runner in front cylinder.
6. Rotate rubber boots under fuel rail and install rubber boots over intake runners.
7. Install fasteners through fuel rail into rubber boots. Tighten to 9.7 Nm (86 **in-lbs**).
8. See Figure 4-10. Orient throttle body intake clamps as shown.
9. Press throttle body and cables into rubber boots.
10. Tighten throttle body intake hose clamps to 1.25 Nm (11 **in-lbs**).
11. Attach the IAC connector [87].
12. Attach the TP sensor connector [88].
13. Install right angle connectors on rigid fuel lines from fuel rail. Push until audible "click" is heard. Lightly tug on lines to verify connection.
14. Install air box and air cleaner. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
15. Install main fuse. See 7.6 MAIN FUSE.

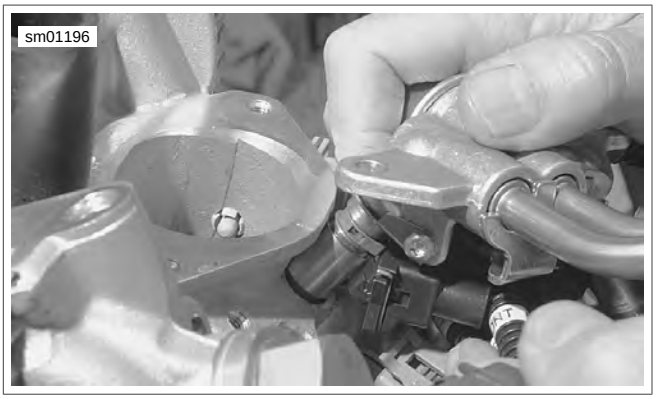


Figure 4-9. Front Injector

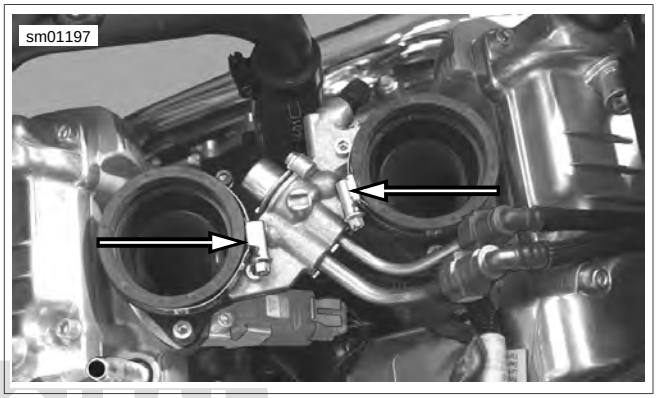


Figure 4-10. Throttle Body Intake Clamps

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

IDLE AIR CONTROL (IAC) 4.6

GENERAL

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

See electrical diagnostic manual for information on the function and testing of the idle air control (IAC).

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

3. See Figure 4-11. Cover air intakes (3) to prevent debris from entering cylinders.
4. Remove throttle body. See 4.5 THROTTLE BODY AND FUEL RAIL.
5. Disconnect throttle cables from throttle body.

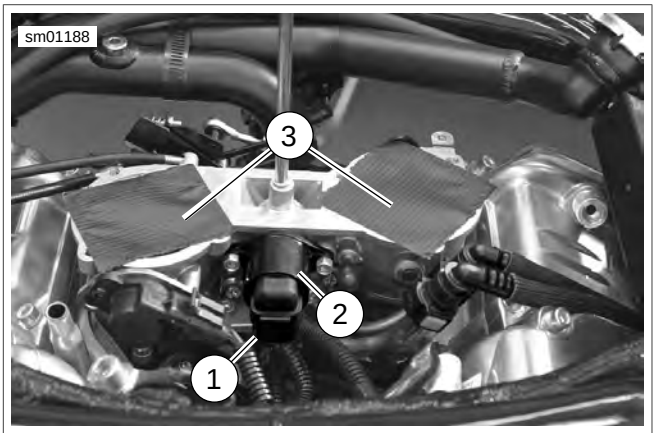
⚠WARNING

If a heat gun is required to remove screws that attach idle control flange to induction module, remove module before proceeding. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00270a)

NOTE

Do not apply excessive heat to idle air control. Apply only enough heat to loosen locking patch on screws. Excessive heat will damage to idle air control.

6. See Figure 4-12. Apply heat to idle air control screws (2) with heat gun to loosen locking patch. Remove screws.
7. Pull IAC (1) and O-ring from throttle body (3).



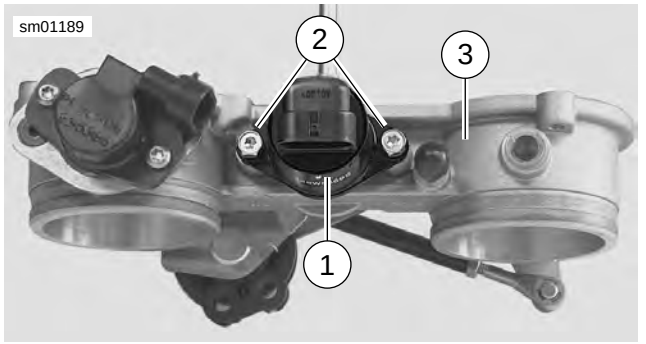
1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Air intakes (covered)**

Figure 4-11. IAC Sensor (typical)

INSTALLATION

FASTENER	TORQUE VALUE	
IAC screws	2-4 Nm	25-35 **in-lbs**

1. Inspect IAC O-ring. Replace IAC if damaged.
2. Apply **clean** engine oil to IAC O-ring.
3. Place IAC and O-ring into throttle body. Seat O-ring in throttle body groove.
4. See Figure 4-12. Apply LOCTITE 243 MEDIUM STRENGTH THREADLOCKER AND SEALANT (blue) to screws (2). Loosely install front and rear IAC screws (2).
5. Tighten front and rear IAC screws to 2-4 Nm (25-35 **in-lbs**).
6. Connect throttle cables to throttle body. See 1.11 THROTTLE CABLES.
7. Install throttle body. See 4.5 THROTTLE BODY AND FUEL RAIL.
8. Install main fuse. See 7.6 MAIN FUSE.
9. Install air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. IAC
2. Screws
3. Throttle body

Figure 4-12. IAC Removal

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) 4.7

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

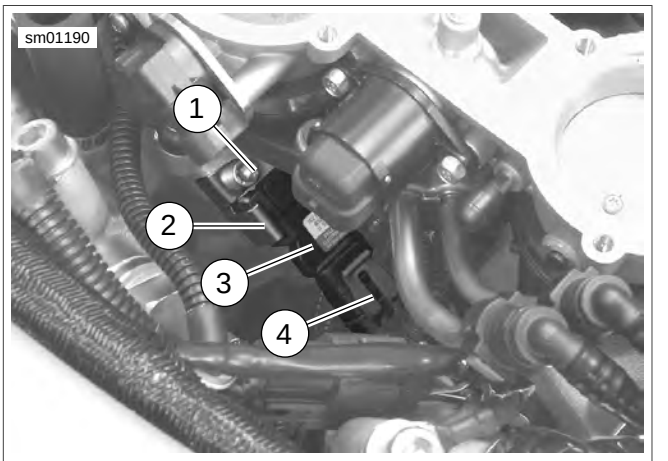
Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

3. Cover air intakes to prevent debris from entering cylinders.
4. See Figure 4-13. Remove bolt (1) securing MAP sensor bracket (2) to front cylinder.
5. Unplug MAP sensor connector [80B] (4) by pulling external latch outward and using rocking motion to remove.

INSTALLATION

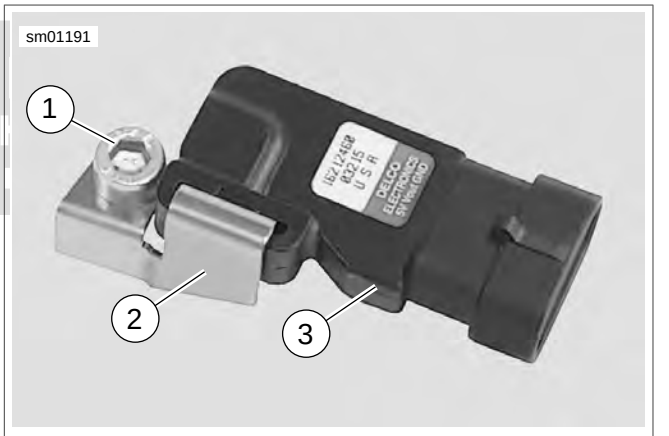
FASTENER	TORQUE VALUE	
MAP sensor bracket bolt	6.0-10.0 Nm	53-88 **in-lbs**

1. Install **new** seal on sensor.
2. Plug connector into MAP sensor.
3. See Figure 4-14. Install bracket (2) over MAP sensor (3).
4. Install (push) MAP sensor and grommet to intake manifold.
5. Secure MAP sensor bracket with bolt. Tighten bolt to 6.0-10.0 Nm (53-88 **in-lbs**).
6. Install main fuse. See 7.6 MAIN FUSE.
7. Install air box and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Bolt**
2. **Bracket**
3. **MAP sensor**
4. **Connector [80B]**

Figure 4-13. MAP Sensor Location (typical)



1. **Bolt**
2. **Bracket**
3. **MAP sensor**

Figure 4-14. MAP Sensor

OXYGEN SENSOR 4.8

REMOVAL

Front Sensor

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

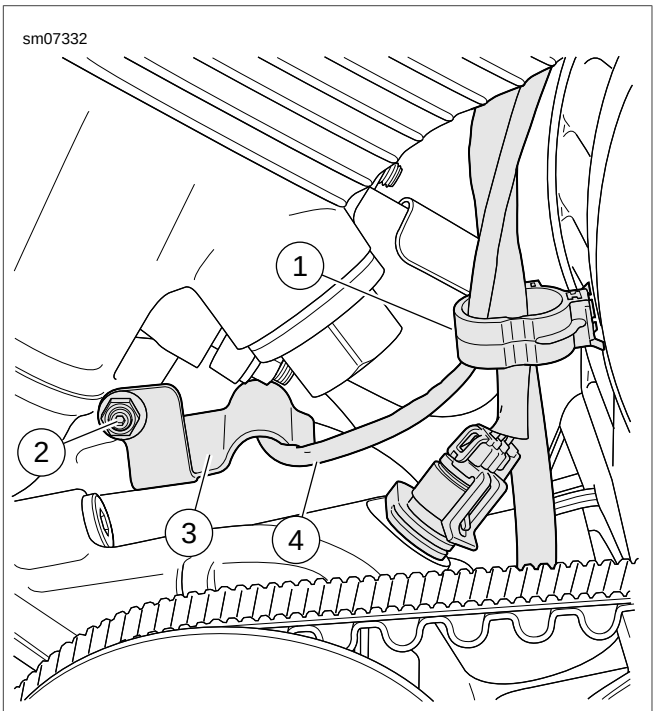
1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove left-side radiator cover. See 1.16 RADIATOR SIDE COVERS.
3. Note routing of sensor harness and locations of cable straps.
4. Locate and disconnect oxygen sensor connector [138] from wiring harness.
5. Remove oxygen sensor from front header.

Rear Sensor

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Note routing of sensor harness and locations of cable straps.
3. Locate and disconnect oxygen sensor connector [137] under seat.
4. See Figure 4-15. Remove oxygen sensor heat shield/bracket (3) located behind rear cylinder head.
5. Remove oxygen sensor from rear header.



1. **Clip**
2. **Heat shield/bracket fastener**
3. **Heat shield/bracket**
4. **wiring**

Figure 4-15. Rear Oxygen Sensor

INSTALLATION

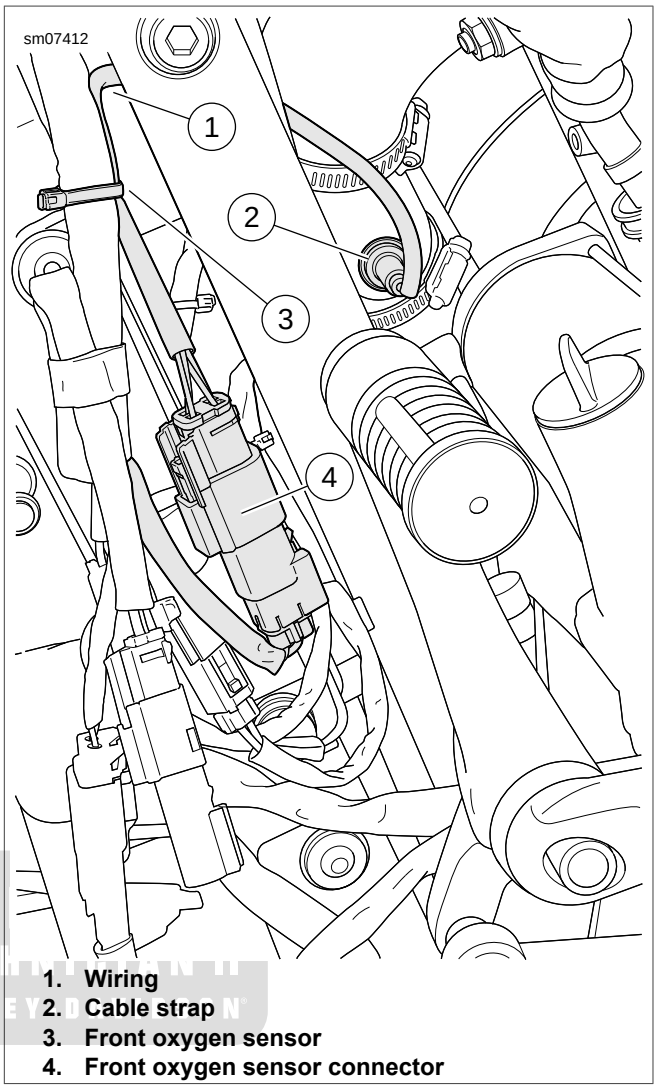
FASTENER	TORQUE VALUE	
Oxygen sensor	16.5-19.5 Nm	12-14 ft-lbs
Oxygen sensor heat shield bracket	8-12 Nm	71-106 **in-lbs**

NOTES

- *Do not install sensors that have been dropped or impacted by other components. Damage to the sensing element may have occurred.*
- *Replacement sensor assemblies have threads coated with anti-seize lubricant and **new** seal rings. If original oxygen sensor will be used, the seal ring must be replaced and a thin coat of ANTI-SEIZE LUBRICANT applied to threads.*
- *Do not use any other grease or sealant product on sensor threads. The electrical connector must also be clean and free of any dielectric grease.*

1. If installing original oxygen sensor:
 a. Remove original seal ring by cutting with high quality side cutters.
 b. Install **new** seal ring with larger side facing exhaust.
 c. Apply a thin coat of ANTI-SEIZE LUBRICANT to threads of oxygen sensor. Use caution not allow anti-seize on sensor ceramic tip.
2. Thread oxygen sensor into header by hand until snug.
3. Final tighten oxygen sensor to 16.5-19.5 Nm (12-14 ft-lbs).
4. Route oxygen sensor cable and replace any cable straps removed during removal:
 a. **Front:** See Figure 4-16. Route wiring (1) to left side of radiator between radiator and frame tube.
 b. **Rear:** See Figure 4-15. Route wiring (4) under heat shield/bracket (2) location and through clip (1).

 Install oxygen sensor heat shield/bracket (3). Tighten fastener (2) to 8-12 Nm (71-106 **in-lbs**).
5. Locate and connect sensor connector to wiring harness.
6. Install main fuse. See 7.6 MAIN FUSE.



1. **Wiring**
2. **Cable strap**
3. **Front oxygen sensor**
4. **Front oxygen sensor connector**

Figure 4-16. Front Oxygen Sensor

FUEL INJECTORS 4.9

GENERAL

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

Refer to electrical diagnostic manual for information on the function and testing of the fuel injectors.

REMOVAL

1. Purge fuel supply line of high pressure gasoline.
 a. Disconnect fuel pump connector [86B] from fuel module assembly.
 b. Start engine and allow vehicle to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove main fuse. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
3. Remove air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
4. Loosen clamps at each intake and lift throttle body straight up.

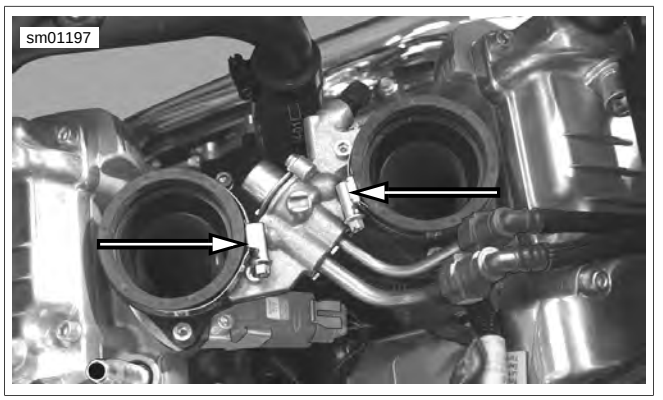


Figure 4-17. Throttle Body Intake Clamps

NOTE

Observe the position of the clamps for reassembly.

5. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. See 4.5 THROTTLE BODY AND FUEL RAIL.

DISASSEMBLY

Fuel Injectors

1. See Figure 4-18. Remove screw (7).
2. Pull fuel injector and clip from induction module.
3. Remove clip from fuel injector.
4. Repeat procedure for other fuel injector.

Fuel Pressure Regulator

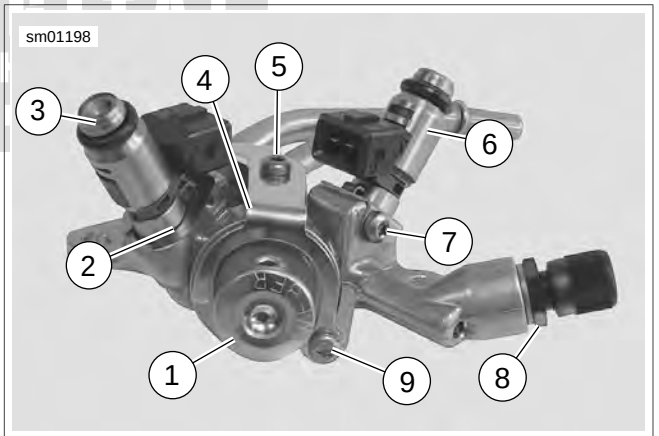
1. See Figure 4-18. Remove screws (5, 9).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. Use rocking motion to detach fuel pressure regulator (1) from fuel rail.

Fuel Tubes

NOTE

Do not remove fuel tubes, O-rings or spacers if not replacing.

1. See Figure 4-18. Remove screws (5, 9).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. See Figure 4-19. Pull feed (4) and return (5) fuel tubes from fuel rail.



1. **Fuel pressure regulator**
2. **Fuel injector clip**
3. **Front fuel injector**
4. **Fuel pressure regulator clip**
5. **Screw**
6. **Rear fuel injector**
7. **Screw**
8. **Schrader valve**
9. **Screw**

Figure 4-18. Fuel Rail

ASSEMBLY

FASTENER	TORQUE VALUE	
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**

Fuel Injectors

1. Replace fuel injector O-rings.
2. Apply **clean** engine oil to fuel injector O-rings.
3. Insert fuel injector into fuel rail.
4. Slide fuel injector clip into slot in fuel injector.
5. Secure with screw and tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).
6. Repeat for other fuel injector.

Fuel Pressure Regulator

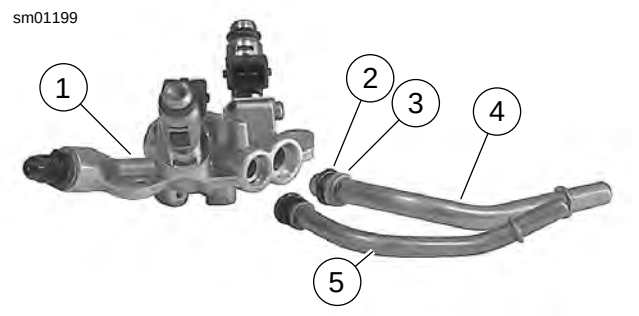
1. Replace fuel pressure regulator O-rings.
2. Apply **clean** engine oil to fuel pressure regulator O-rings.
3. Install fuel pressure regulator into bore in fuel rail.
4. See Figure 4-18. Install fuel pressure regulator clip over fuel tubes and regulator.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

Fuel Tubes

1. See Figure 4-19. Install washers (3) over fuel tube.
2. Apply **clean** engine oil to **new** fuel tube O-rings (2).
3. Install feed and return fuel tubes into proper holes in fuel rail.
4. See Figure 4-18. Install fuel pressure regulator clip over fuel tubes.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

INSTALLATION

1. Install fuel rail and throttle body. See 4.5 THROTTLE BODY AND FUEL RAIL.
2. Install main fuse. See 7.6 MAIN FUSE.
3. Install air box and filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Fuel rail**
2. **O-ring**
3. **Washer**
4. **Feed fuel tube**
5. **Return fuel tube**

Figure 4-19. Fuel Tubes

FUEL TANK 4.10

REMOVAL

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

WARNING

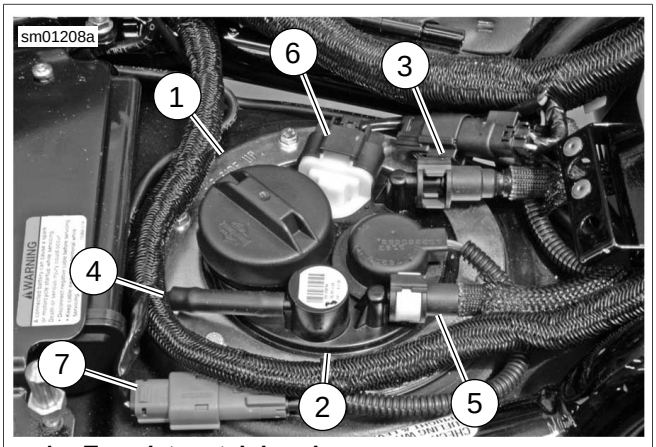
To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge fuel supply line of high pressure gasoline.
 a. See Figure 4-20. Disconnect fuel pump connector (6) [86B] from fuel module assembly.
 b. Start engine and allow vehicle to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove main fuse. See 7.6 MAIN FUSE.
3. Remove air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Top plate retaining ring**
2. **Top plate**
3. **Pressure fuel line**
4. **Vapor vent hose**
5. **Return fuel line**
6. **Fuel pump connector [86B]**
7. **Fuel level sensor connector [13B]**

Figure 4-20. Fuel Tank Top Plate

WARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

NOTE

Always drain fuel tank using the proper equipment. Store fuel in a suitable container when fuel module is removed unless repairs can be completed immediately.

4. Disconnect both fuel lines from fuel tank top plate. Pull lines out of path of fuel module assembly.
5. Remove vapor vent hose (4) from outlet tube.
6. Disconnect fuel level sensor connector (7) [13B].
7. Check that all components are out of path of fuel module assembly.
8. Remove six fasteners from top plate retaining ring (1) and remove retaining ring.
9. Lift fuel module assembly out of the fuel tank.
10. Cover fuel tank opening or drain fuel tank as required.
11. Remove rear wheel and rear fork. See 2.26 REAR WHEEL and 2.37 REAR FORK.
12. Remove passenger pillion and rear fender.
13. Remove the mud flap by pinching side tabs to disengage from seat pan.
14. Remove two screws and washers securing the fuel tank against the frame.
15. Remove fuel tank from motorcycle.

CLEANING AND INSPECTION

1. Drain the fuel tank. Use a common pump or siphon and an approved gasoline storage container of sufficient capacity.
2. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent.
3. Flush the tank thoroughly after cleaning and allow it to air dry.

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

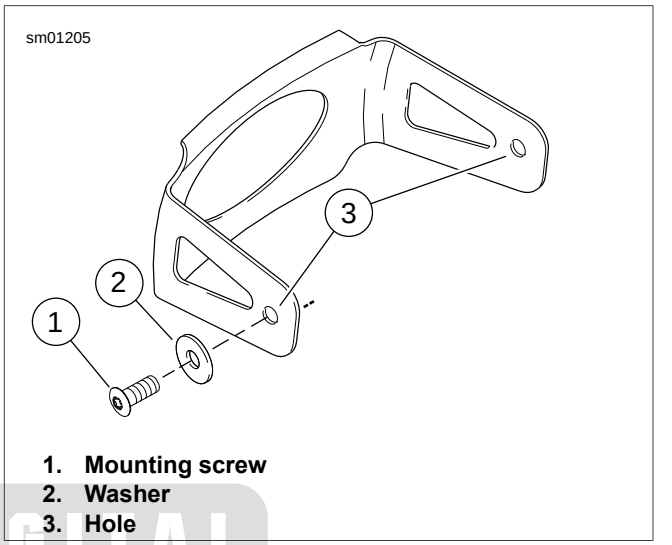
4. Inspect the evaporative emissions system vapor valve line and pressure and return fuel lines for cuts, cracks or holes. Replace lines as needed.

5. Inspect the tank for leaks and other damage. Replace if necessary.

INSTALLATION

FASTENER	TORQUE VALUE	
Fuel tank mounting fasteners	40-48 Nm	30-35 ft-lbs

1. Position the fuel tank in the frame and position the fuel tank mounting bracket to the frame.
2. See Figure 4-21. Loosely install the two mounting screws and washers through the holes of the bracket into the threaded boss on the frame.
3. Tighten the mounting bolts to 40-48 Nm (30-35 ft-lbs).
4. Install fuel module assembly into fuel tank.
5. Install top plate retaining ring and fasteners. See 4.11 FUEL MODULE ASSEMBLY.
6. See Figure 4-20. Connect fuel pump connector (6) [86B] and fuel level sensor connector (7) [13B].
7. Install the smaller return line and the larger pressure line while supporting the mating port. Press the lines on until the click is heard that indicates engagement. Tug on lines to verify engagement.
8. Press on the vapor vent hose while supporting the mating port with the opposite hand.
9. Install mud flap and stud plate.
10. Install rear fender and passenger pillion.
11. Install rear fork. See 2.37 REAR FORK.
12. Install the rear wheel assembly and adjust the drive belt tension. See 2.26 REAR WHEEL.
13. Install air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
14. Close seat.
15. Install main fuse and right side cover.
16. Check fuel system pressure. See 4.13 FUEL PRESSURE TEST.



1. **Mounting screw**
2. **Washer**
3. **Hole**

Figure 4-21. Fuel Tank Mounting Bracket (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FUEL MODULE ASSEMBLY 4.11

REMOVAL

1. Open seat.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

⚠WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

2. Purge fuel supply line of high pressure gasoline.
 a. See Figure 4-22. Disconnect fuel pump connector (6) [86B] from fuel module assembly.
 b. Start engine and allow vehicle to run.
 c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.

⚠WARNING

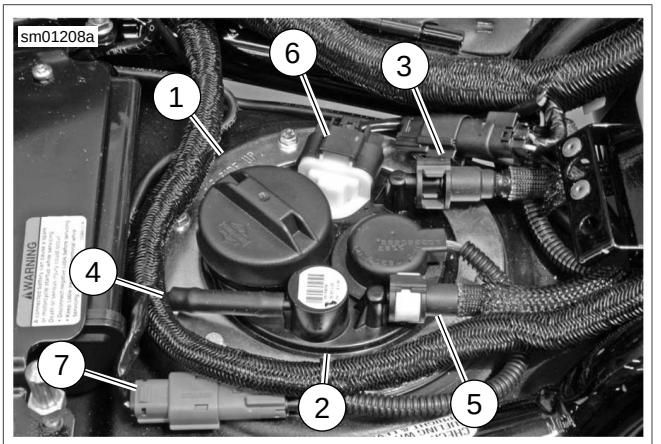
To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Remove main fuse. See 7.6 MAIN FUSE.
4. Remove air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTE

Be sure to drain fuel tank using the proper equipment and store fuel in a suitable container when fuel module assembly is removed unless repairs can be completed immediately.

5. If repairs can not be completed immediately, drain fuel tank. See 4.10 FUEL TANK.



1. **Top plate retaining ring**
2. **Top plate**
3. **Pressure fuel line**
4. **Vapor vent hose**
5. **Return fuel line**
6. **Fuel pump connector [86B]**
7. **Fuel level sensor connector [13B]**

Figure 4-22. Fuel Tank Top Plate

⚠WARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

6. At fuel rail, disconnect pressure fuel line (3), return fuel line (5) by compressing tabs with thumb and first finger.
7. Disconnect both fuel lines from fuel tank top plate. Pull lines out of path of fuel module assembly.
8. Disconnect vapor vent hose (4).
9. Disconnect fuel level sensor connector (7) [13B].
10. Check that all components are out of path of fuel module assembly.

NOTE

Fuel module assembly is lightly spring loaded and will generate a small amount of upward force when fasteners are removed.

11. See Figure 4-22. Remove six fasteners from top plate retaining ring (1) and remove retaining ring.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

12. Lift fuel module assembly out of the fuel tank.
13. Cover fuel tank opening or drain fuel tank as required.

INSTALLATION

FASTENER	TORQUE VALUE	
Top plate fasteners	5-6 Nm	44-53 **in-lbs**

1. See Figure 4-23. Install **new** fuel tank top plate O-ring onto shoulder of tank opening.

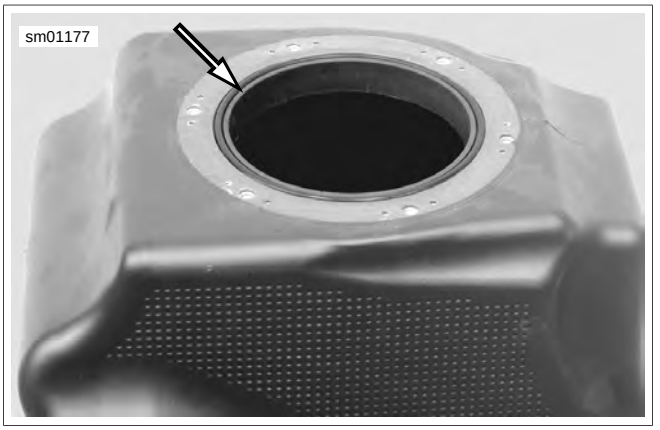


Figure 4-23. Fuel Tank O-ring (typical)

NOTE

Fuel module assembly is lightly spring loaded and requires a small amount of downward force when installing. Be sure not to pinch hoses when compressing assembly as this will obstruct fuel flow.

2. Insert fuel module assembly into fuel tank.

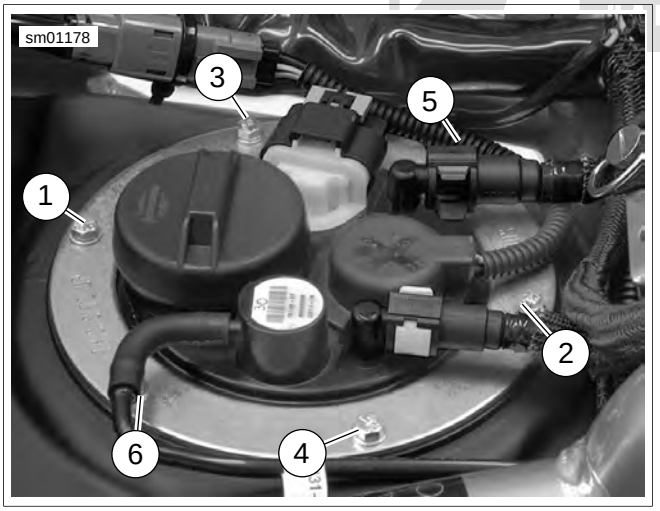


Figure 4-24. Torque Sequence

3. See Figure 4-24. Install top plate retaining ring and fasteners. Tighten to 5-6 Nm (44-53 **in-lbs**).

4. See Figure 4-22. Mate fuel pump connector half (6) [86B], and fuel level sensor connector (7) [13B] while supporting the top plate connector half with opposite hand.

NOTE

To avoid bending connector pins, gently press connectors parallel or straight into pin module connectors.

5. See Figure 4-22. Install return fuel line and larger pressure fuel line while supporting mating port. Press lines on until an audible click is heard that indicates engagement.

6. Lightly tug on lines to verify engagement.

NOTE

Always connect fuel lines to correct ports and verify fuel lines are properly installed before starting vehicle. Failure to connect fuel lines properly can result in a spray of gasoline when ignition switch is turned on.

7. Press on fuel vapor vent hose while supporting mating port.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

8. Install air box. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

9. Close seat.

10. Install the main fuse. See 7.6 MAIN FUSE.

11. Check fuel system pressure and check for leaks. See 4.13 FUEL PRESSURE TEST.

SUCTION SIDE FUEL FILTER

⚠WARNING

Gasoline can drain from components when disconnected from fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00273a)

See Figure 4-26. The suction side filter filters the fuel as it enters the strained intake of the fuel pump. Replace the suction side filter every 161,000 kilometers (100,000 miles).

Removal

Press suction side fuel filter mounting tabs (7) and disconnect suction side filter (4).

Installation

Press **new** suction side filter (4) into place until an audible click is heard.

PRESSURE SIDE FUEL FILTER

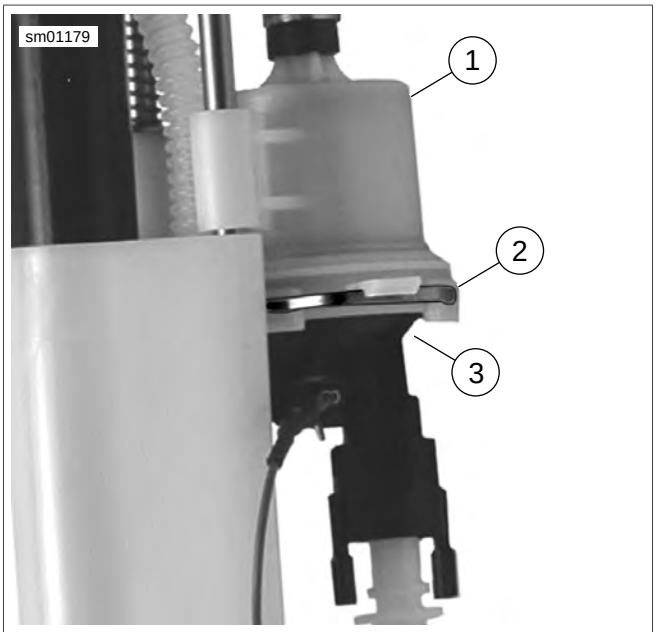
See Figure 4-25. The pressure side filter filters the fuel before it enters the pressure fuel line. Replace the pressure side filter every 161,000 kilometers (100,000 miles) or any time the fuel pump is serviced.

Removal

1. See Figure 4-25. To remove, slide clip (2) outward.

2. Disconnect base (3) from fuel filter canister (1).

3. Pull fuel O-ring and filter from fuel filter canister.



1. **Fuel filter canister**
2. **Fuel filter canister clip**
3. **Fuel filter base**

Figure 4-25. Pressure Side Filter

Installation

1. Insert a **new** pressure side filter and O-ring into fuel filter canister (1).
2. Install fuel filter base (3).
3. Slide fuel filter canister clip into place until an audible click is heard (2).

FUEL PUMP

General

The fuel pump pumps fuel from the tank sump and provides filtered, pressurized fuel to the fuel rail. The fuel rail pressure is controlled by a pressure regulator. The injectors receive fuel directly from the fuel rail. The bypass fuel from the pressure regulator is returned to the tank sump via the external fuel return line.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

NOTE

Before removing the fuel pump, perform appropriate diagnostics listed in the electrical diagnostic manual.

Removal

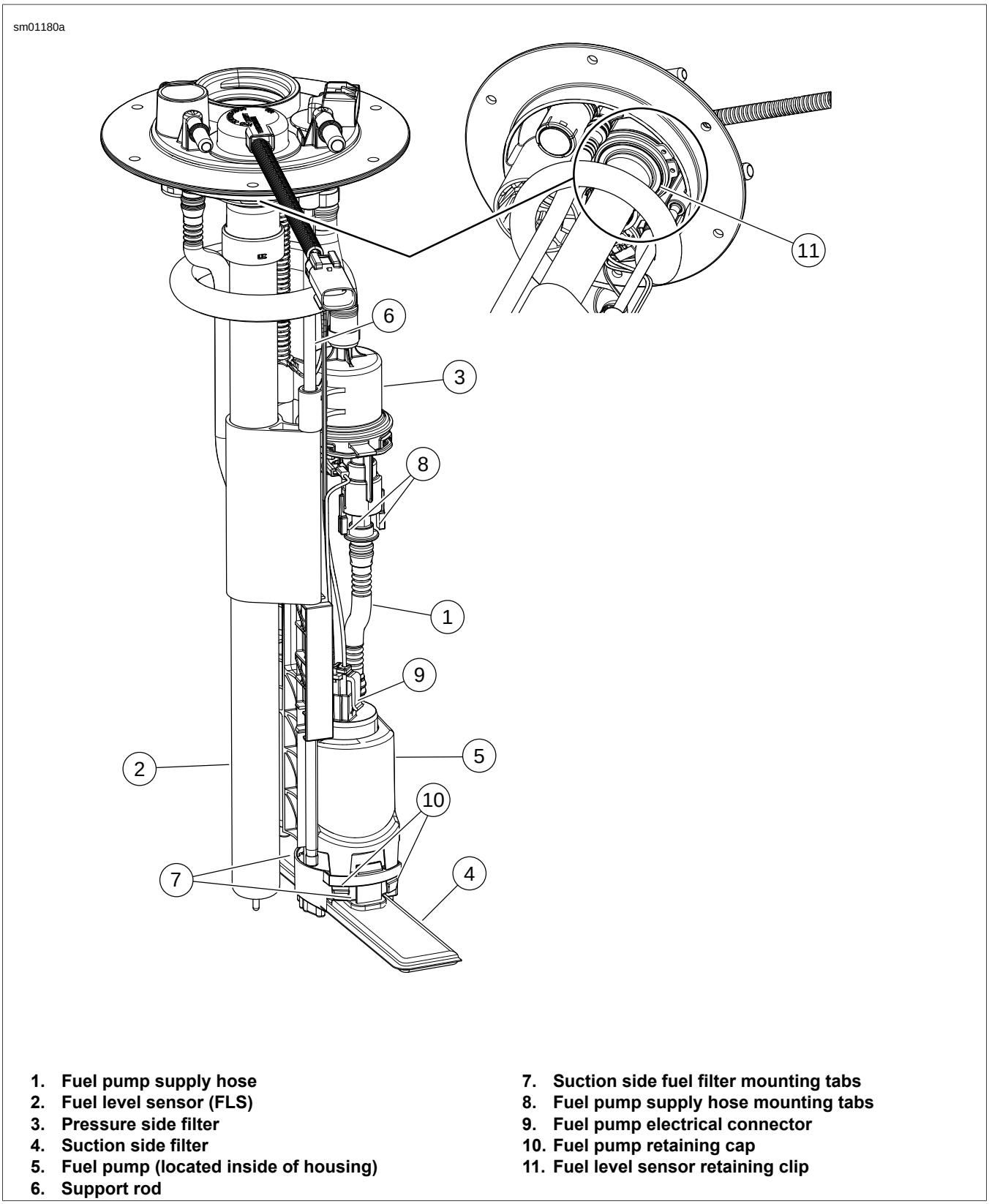
1. See Figure 4-26. Remove fuel pump electrical connector (9) from fuel pump.
2. Press fuel pump supply hose mounting tabs (8) and disconnect fuel pump supply hose (1).
3. Press suction side fuel filter mounting tabs (7) and disconnect suction side filter (4).
4. Remove fuel pump (5) and vibration isolator (rubber damper) from housing.
5. Push fuel pump up and out of its bracket.
6. Inspect all fuel pump and fuel level sending unit wiring.

NOTE

Carefully inspect hoses for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.

Installation

1. See Figure 4-26. Route fuel pump supply hose (1) through cavity in fuel pump housing and install **new** fuel pump (5) with vibration isolator (rubber damper) into housing.
2. Insert fuel pump supply hose into fuel filter canister base until an audible click is heard.
3. Align fuel pump so suction side filter pickup is located between two fuel pump retaining cap mounting tabs and install fuel pump retaining cap but pushing cap into place until an audible click is heard.
4. Install **new** suction side filter (4) by pressing into place until an audible click is heard.
5. Press fuel pump electrical connector (9) into place until an audible click is heard.
6. Install fuel module into fuel tank.
7. After installation of fuel module assembly, verify fuel pump operation with a fuel system pressure test. See 4.13 FUEL PRESSURE TEST.



1. Fuel pump supply hose
2. Fuel level sensor (FLS)
3. Pressure side filter
4. Suction side filter
5. Fuel pump (located inside of housing)
6. Support rod
7. Suction side fuel filter mounting tabs
8. Fuel pump supply hose mounting tabs
9. Fuel pump electrical connector
10. Fuel pump retaining cap
11. Fuel level sensor retaining clip

Figure 4-26. Fuel Module Assembly (typical)

FUEL LEVEL SENSOR

⚠WARNING

Gasoline can drain from components when disconnected from fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00273a)

Removal

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 4-26. Using a snap-ring pliers, remove fuel level sensor retaining clip (11).
2. Slide fuel level sensor (2) up and out top plate of fuel pump/filter/fuel level sensor assembly.

Installation

1. See Figure 4-26. Slide fuel level sensor assembly into top plate of fuel module assembly.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

2. Using snap-ring pliers, install fuel level sensor retaining clip (11).
3. Install fuel module assembly into fuel tank.
4. Connect fuel level sensor connector [13B].
5. Verify the fuel gauge indicates the corresponding fuel level after installing the fuel module assembly.

NOTE

Fill fuel tank and ride vehicle 1-2 miles for fuel vapor to fully saturate the fuel tank and then verify fuel level sending unit operation. Do not check with vehicle resting on jiffy stand.

DIGITAL TECHNICIAN® II HARLEY-DAVIDSON®

VAPOR VALVE 4.12

GENERAL

See Figure 4-27. The vapor valve is mounted in the fuel tank top plate. Hydrocarbon vapors in the fuel tank are vented through the vapor valve and then through the vapor valve hose to the carbon canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.

REPLACEMENT

The vapor valve is integrated into the fuel tank top plate and is not individually replaceable. The fuel tank top plate must be replaced.

NOTE

On non-EVAP models, the bottom hose is vented to the atmosphere. On EVAP models, the hose from the vapor valve bottom fitting goes to a evaporative (EVAP) emissions control system. See 4.17 EVAPORATIVE EMISSIONS CONTROL.

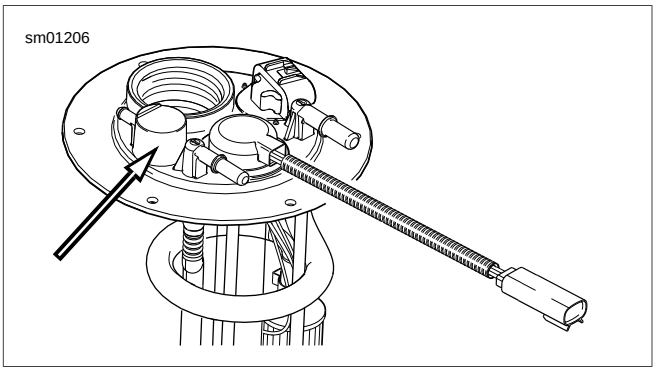


Figure 4-27. Vapor Valve

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

FUEL PRESSURE TEST 4.13

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors, and the pressure regulator where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 VDC to the fuel pump.

When the engine is stopped, the fuel pump can be turned on by applying battery voltage to pin 1 and ground to pin 3 of the fuel pump connector [86A] or by using DIGITAL TECHNICIAN II (Part No. HD-48650).

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

NOTE

See the electrical diagnostic manual for further information on the function and testing of the fuel system.

TESTING

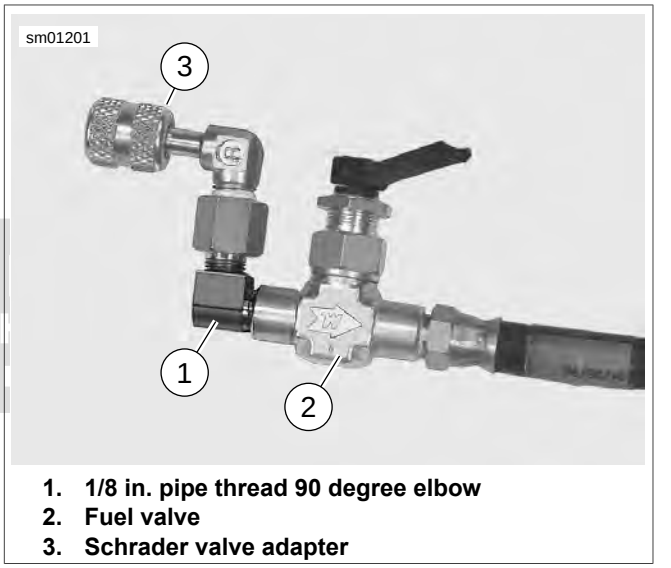
PART NUMBER	TOOL NAME
HD-41182	FUEL PRESSURE GAUGE

The fuel pressure gauge allows for fuel injector and fuel system pressure diagnosis.

1. See Figure 4-28. Disconnect fuel pump electrical connector [86] from fuel module assembly.
2. Start the engine and allow the vehicle to run.
3. When engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines. Turn ignition key off.
4. See Figure 4-29. Insert a 1/8 in. pipe thread 90 degrees (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
5. See Figure 4-30. Remove protective cap from Schrader valve in fuel metering assembly.
6. Verify that the fuel valve and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.



Figure 4-28. Fuel Pump Connector [86] (typical)



1. **1/8 in. pipe thread 90 degree elbow**
2. **Fuel valve**
3. **Schrader valve adapter**

Figure 4-29. Fuel Pressure Gauge Valves

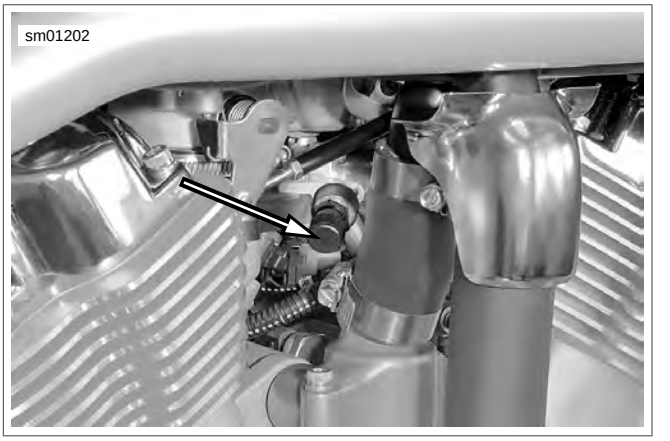


Figure 4-30. Schrader Valve Location (typical)

7. Connect fuel pressure gauge to Schrader valve.
8. Connect the fuel pump connector.

9. Start and idle the engine to pressurize the fuel system.
10. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
11. Position the clear air bleed tube in a suitable container.
12. Open and close the air bleed petcock to purge the gauge and hose of air. Repeat several times until only solid fuel (without bubbles) flows from the air bleed tube.
13. Close the petcock.
14. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 kPa (55-62 psi).
15. Turn off the engine and watch the fuel pressure gauge. If the pressure drops it indicates a defective line, regulator, injector or pump check valve. Refer to Table 4-2.
16. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

⚠WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

17. Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

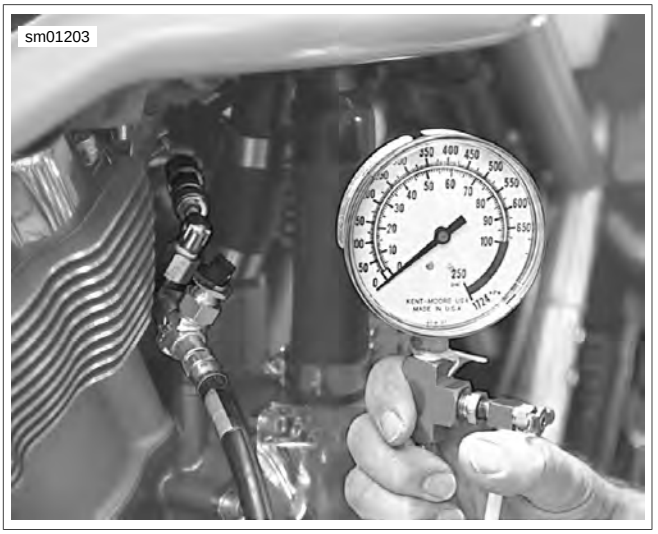


Figure 4-31. Fuel Pressure Gauge Installed

Table 4-2. Fuel Pressure Test

RESULTS	CAUSE	SOLUTION
Less than: 380 kPa (55 psi)	Restricted fuel filter	Replace.
	Restricted pump inlet screen	Clean.
	Restricted fuel line or hose to gauge	Clear.
	Faulty fuel pump	Replace.
	Restricted check valve fitting	Clear.
	Leak inside tank (hose or coupling)	Repair or replace as necessary.
	Faulty pressure regulator	Replace.
Steady at: 380-425 kPa (55-62 psi)	Operating fuel pressure	
More than: 425 kPa (62 psi)	Check valve fitting and fuel tank	Replace as necessary.
	Fuel pressure regulator	Replace.

EXHAUST SYSTEM: VRSCDX 4.14

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

NOTE

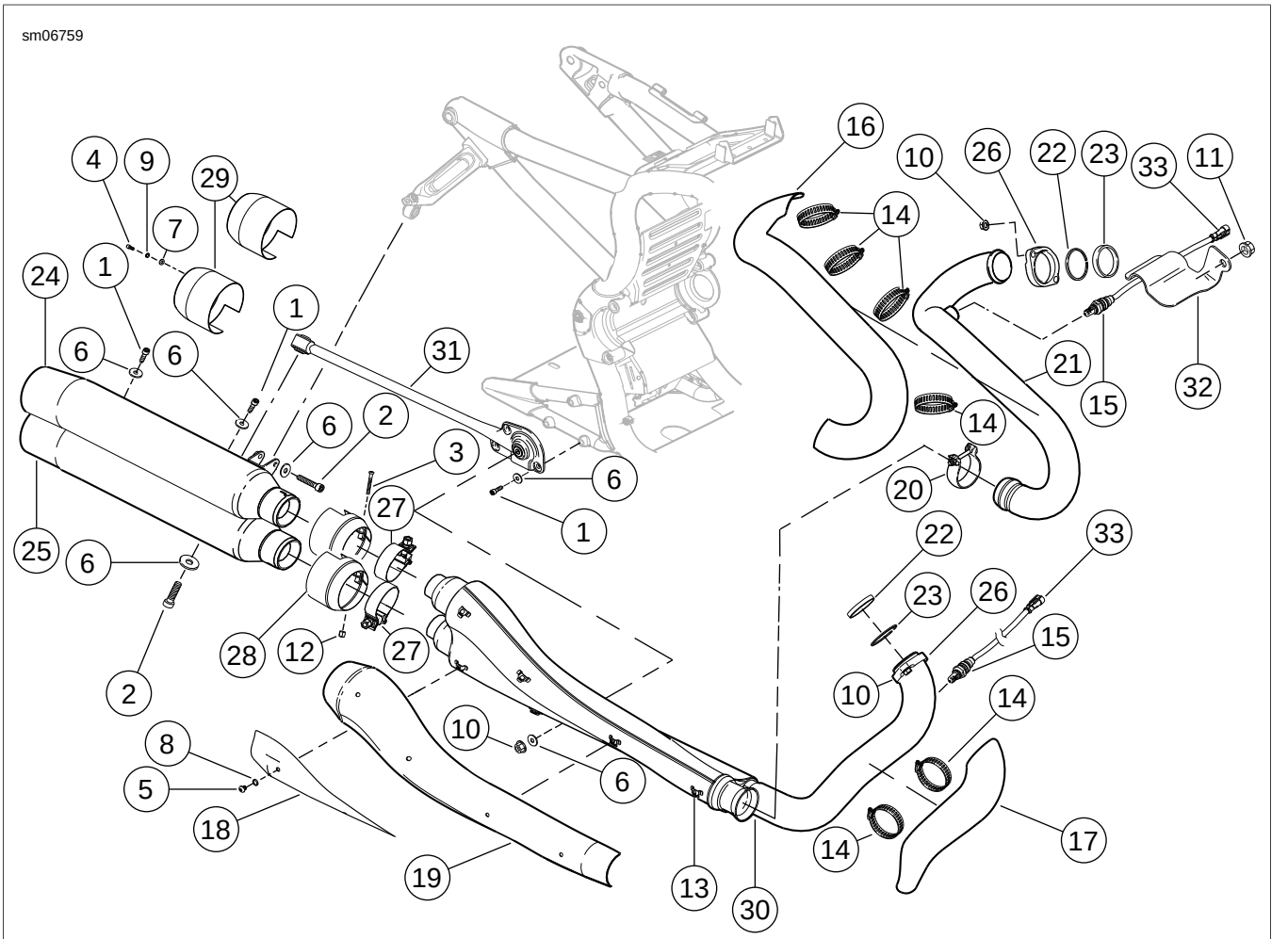
The VRSCDX uses a unique finish on some exhaust system components. Improper care and handling during the disassembly/assembly process can cause permanent cosmetic damage.

1. Remove main fuse. See 7.6 MAIN FUSE.
2. See Figure 4-32. Remove exhaust heat shields (16, 17, 18, 19).
3. Remove left drive sprocket cover for easier access to rear exhaust flange nuts.
4. Remove nuts (10) holding exhaust flanges to cylinder heads.
5. Loosen clamp (20).
6. Loosen but do not remove nut (11) from oxygen sensor bracket (32).
7. Disconnect oxygen sensor connectors (33) from wiring harness.
8. Remove rear exhaust pipe (21).
9. Loosen clamps (27).
10. Remove screws (1) and screw (2) from upper muffler (24) and remove muffler from motorcycle.
11. Remove screw (2) and remove lower muffler (25) from motorcycle.
12. **VRSCDX models:** Remove endcaps (28, 29) by removing screws (3,4).
13. Remove lower nut (10) from bottom of auxiliary volume (30) and remove auxiliary volume from motorcycle.

NOTE

It is not necessary to remove exhaust support assembly (31) from motorcycle.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Screw (5)
2. Screw (2)
3. Screw (4)
4. Screw (6)
5. Screw (6)
6. Washer (7)
7. Washer (6)
8. Washer (6)
9. Lockwasher (6)
10. Nut (5)
11. Nut
12. Nut (4)
13. Nut (6)
14. Clamp (6)
15. Oxygen sensor
16. Shield, exhaust rear
17. Shield, exhaust front
18. Shield, lower exhaust
19. Shield, upper exhaust
20. Clamp, exhaust
21. Exhaust pipe, rear
22. Seal, exhaust (2)
23. Retaining ring (2)
24. Muffler, top
25. Muffler, bottom
26. Flange, exhaust (2)
27. Clamp, exhaust (2)
28. Endcap, muffler inlet (2) (VRSCDX only)
29. Endcap, muffler outlet (2) (VRSCDX only)
30. Auxiliary volume
31. Support assembly, exhaust
32. Bracket, oxygen sensor
33. Oxygen sensor connector

Figure 4-32. Exhaust System VRSCDX, VRSCDX ANV

INSTALLATION

FASTENER	TORQUE VALUE	
Muffler outlet endcap screws	1.7 to 2.3 Nm	15.0 to 20.3 **in-lbs**
Muffler inlet endcap screws	0.6 to 1.2 Nm	5.3 to 10.6 **in-lbs**
Upper muffler clamp	65 Nm	48 ft-lbs
Upper muffler screws	23 Nm	17 ft-lbs
Lower muffler clamp	65 Nm	48 ft-lbs
Lower muffler screws	23 Nm	17 ft-lbs
Auxiliary volume screws	23 Nm	17 ft-lbs
Rear exhaust pipe to auxiliary volume clamp	13-17 Nm	115-150 **in-lbs**
Exhaust flange nuts	8-12 Nm	71-106 **in-lbs**
Heat shield screws	10 Nm	88 **in-lbs**
Drive sprocket cover screws	6-10 Nm	53-88 **in-lbs**
Oxygen sensor bracket nut	8-10 Nm	71-88 **in-lbs**

⚠WARNING

When routing wires and harnesses, ensure that they are clear of moving parts, heat sources and pinch points to avoid wire damage or a short circuit, which could cause loss of control resulting in death or serious injury. (00554b)

NOTES

- *Before installing exhaust system, verify brake lines, clutch line and wiring along frame is installed securely. Verify no clamps are missing, damaged or contacting the exhaust system.*
- *If auxiliary volume heat shield fasteners were removed from exhaust system, replace them with **new** fasteners.*
- *Use an assistant to hold the exhaust pipes while guiding exhaust system onto motorcycle.*

1. See Figure 4-32. Install **new** exhaust seals (22) and retaining rings (23).
2. Gently lift auxiliary volume (30) into position.
3. Slip front exhaust flange (26) over studs on front cylinder head and thread nuts (10) on flange studs. Do not tighten.
4. Install lower auxiliary volume nut (10).
5. **VRSCDX models:**
 a. Install muffler outlet endcaps (29), washers (7), lock-washers (9) and screws (4) on mufflers. Tighten screws to 1.7 to 2.3 Nm (15.0 to 20.3 **in-lbs**).
 b. Install muffler inlet endcaps (28), screws (3) and nuts (12) on mufflers. Tighten screws to 0.6 to 1.2 Nm (5.3 to 10.6 **in-lbs**).
6. Install rear exhaust pipe (21) using **new** clamp (20).
7. Slip exhaust pipe flange (26) over studs on rear cylinder head and thread nuts (4) on flange studs. Do not tighten.
8. Install **new** clamp (27) on lower muffler (25). Slide muffler over lower opening of auxiliary volume. Position clamp with fastener inboard with tightening nut facing upward.
9. Install **new** clamp (27) on upper muffler (24). Slide muffler over upper opening of auxiliary volume. Position clamp with fastener inboard with tightening nut facing upward.
10. Install screws (1) into mufflers as shown. Do not tighten.
11. Install screw (2) connecting upper muffler to footrest. Do not tighten.
12. Tighten fasteners to specified torque value in the following order:
 a. Upper muffler clamp to 65 Nm (48 ft-lbs).
 b. Upper muffler screws to 23 Nm (17 ft-lbs).
 c. Lower muffler clamp to 65 Nm (48 ft-lbs).
 d. Lower muffler screws to 23 Nm (17 ft-lbs).
 e. Auxiliary volume screws to 23 Nm (17 ft-lbs).
 f. Rear exhaust pipe to auxiliary volume clamp to 13-17 Nm (115-150 **in-lbs**).
 g. Exhaust flange nuts to 8-12 Nm (71-106 **in-lbs**).
13. Install heat shields using **new** screws. Tighten heat shield screws to 10 Nm (88 **in-lbs**).
14. Install drive sprocket cover. Tighten to 6-10 Nm (53-88 **in-lbs**).
15. Mate oxygen sensor connectors to wiring harness.
16. Install oxygen sensor bracket (32) and tighten nut (11) to 8-10 Nm (71-88 **in-lbs**).
17. Install main fuse. See 7.6 MAIN FUSE.
18. Check clearance between frame and exhaust system. Clearance should be no less than 5.7 mm (7/32 in). If adjustment is necessary, loosen exhaust pipes, all mounting fasteners and reposition exhaust system and check clearance again.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

EXHAUST SYSTEM: VRSCF 4.15

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. See Figure 4-33. Remove upper right heat shield (4), lower right heat shield (5) and left heat shield (6).
3. Disconnect front and rear oxygen sensors (14).

NOTES

- *Do not remove the fastener securing the rear of each muffler to the pin in the end of the exhaust support. When removing the muffler, the exhaust support pin will remain with each muffler and the rubber isolator will remain with the exhaust support.*
- *TORCA clamps are spot welded to the header pipe and will require a twisting action to remove.*

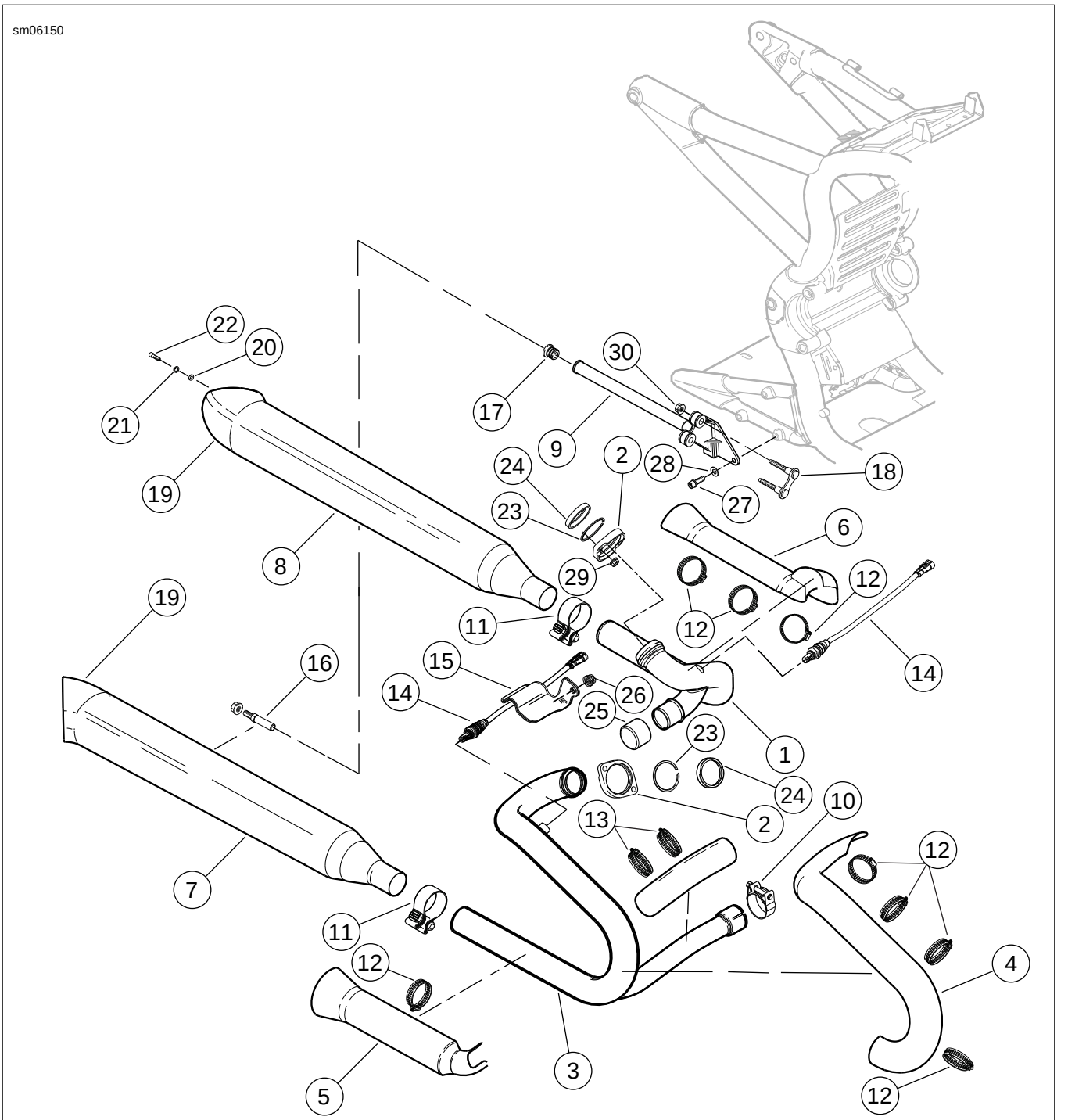
4. Loosen TORCA clamps (11) securing mufflers (7, 8) to exhaust pipes (1, 3).
5. Remove fasteners on stud plates (18) securing mufflers to left and right exhaust supports (9).
6. Remove stud plates.
7. Remove mufflers, one at a time.

NOTES

- *If muffler end caps must be replaced, remove screws (22), washers (20) and lockwashers (21) and remove end caps and replace as necessary.*
- *There are different end caps for non-HDI and HDI models. Consult the correct parts book for part replacement.*

8. Loosen TORCA clamp (10) securing rear exhaust crossover pipe (3) to front exhaust pipe (1).
9. Remove the flanged hex-nuts holding exhaust flanges (2) to front and rear cylinder heads.
10. Slide exhaust flange down header pipe to improve clearance around exhaust port.
11. Remove rear exhaust pipe (3).
12. Remove TORCA clamp from crossover pipe. Discard TORCA clamp.
13. Remove front exhaust pipe (1).
14. Remove and discard exhaust seal (25) from exhaust pipe, remove retaining rings (23) and exhaust seals (24) from front and rear exhaust ports.

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1. Exhaust pipe, front
2. Flange, exhaust (2)
3. Exhaust pipe, rear
4. Shield, upper right
5. Shield, lower right
6. Shield, left
7. Muffler, right
8. Muffler, left
9. Exhaust support, right (left not shown)
10. Clamp, crossover
11. Clamp, exhaust (2)
12. Clamps, shields (8)
13. Clamps, crossover shield (2)
14. Oxygen sensor, front and rear
15. Bracket, rear oxygen sensor
16. Pin (2)
17. Isolator (2)
18. Stud plate (2)
19. End cap (2)
20. Washer (8)
21. Lock washer (8)
22. Screw (8)
23. Retaining ring (2)
24. Seal (2)
25. Exhaust seal
26. Nut
27. Screw (6)
28. Washer (6)
29. Nut (6)
30. Nut (6)

Figure 4-33. Exhaust System (VRSCF)

INSTALLATION

FASTENER	TORQUE VALUE	
Crossover TORCA clamp	13-15 Nm	115-133 **in-lbs**
Cylinder head exhaust flange nuts, front	8-12 Nm	71-106 **in-lbs**
Cylinder head exhaust flange nuts, rear	8-12 Nm	71-106 **in-lbs**
Exhaust bracket stud plate fasteners	19-27 Nm	14-20 ft-lbs
Muffler TORCA clamps	52-58 Nm	38-43 ft-lbs
Muffler heat shield fasteners	2.3-4.5 Nm	20-40 **in-lbs**

NOTES

- *Always loosely assemble exhaust system on motorcycle before following tightening procedure.*
- *When installing mufflers make sure to insert the pins on the mufflers into the isolators in the end of the exhaust support tubes.*
- *TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To guarantee sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that the muffler clamp assemblies be discarded and replaced each time they are removed.*

1. See Figure 4-33. Install front and rear exhaust pipe seals (with the tapered side out).
2. Install rear exhaust pipe (3) to cylinder head.
3. Install **new** TORCA clamp (10) on rear exhaust pipe crossover (3).
4. Install **new** exhaust seal (25), then twist and push flange on front exhaust crossover (1) into rear exhaust crossover pipe (3). Install front exhaust pipe to cylinder head using new seals (24) and retaining rings (23).
5. Install mufflers (7, 8) one at a time.
6. Install stud plates (18) with fasteners.
7. Tighten the exhaust system as follows:
 a. Making sure the crossover connection is fully seated, tighten TORCA clamp (10) to 13-15 Nm (115-133 **in-lbs**).
 b. Tighten the top and bottom nut of the front cylinder head exhaust flange (2) to 8-12 Nm (71-106 **in-lbs**).
 c. Tighten the top and bottom nut of the rear cylinder head exhaust flange to 8-12 Nm (71-106 **in-lbs**).
 d. Tighten fasteners on exhaust bracket stud plate to 19-27 Nm (14-20 ft-lbs).
 e. Tighten the two TORCA clamps on the mufflers to 52-58 Nm (38-43 ft-lbs).
8. Install heat shields on exhaust pipes. Position each clamp so that screw is on the outboard side in the most accessible position and then tighten to 2.3-4.5 Nm (20-40 **in-lbs**).
9. Connect front and rear oxygen sensors (14).
10. Install the main fuse and the right side cover.

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INTAKE LEAK TEST 4.16

GENERAL

⚠WARNING

Do not allow open flame or sparks near propane. Propane is extremely flammable, which could cause death or serious injury. (00521b)

⚠WARNING

Read and follow warnings and directions on propane bottle. Failure to follow warnings and directions can result in death or serious injury. (00471b)

NOTES

- *To prevent false readings, keep air cleaner cover installed when performing test.*
- *Do not direct propane into air cleaner or false readings will result.*

LEAK TESTER

PART NUMBER	TOOL NAME
HD-41417	PROPANE ENRICHMENT KIT

Parts List

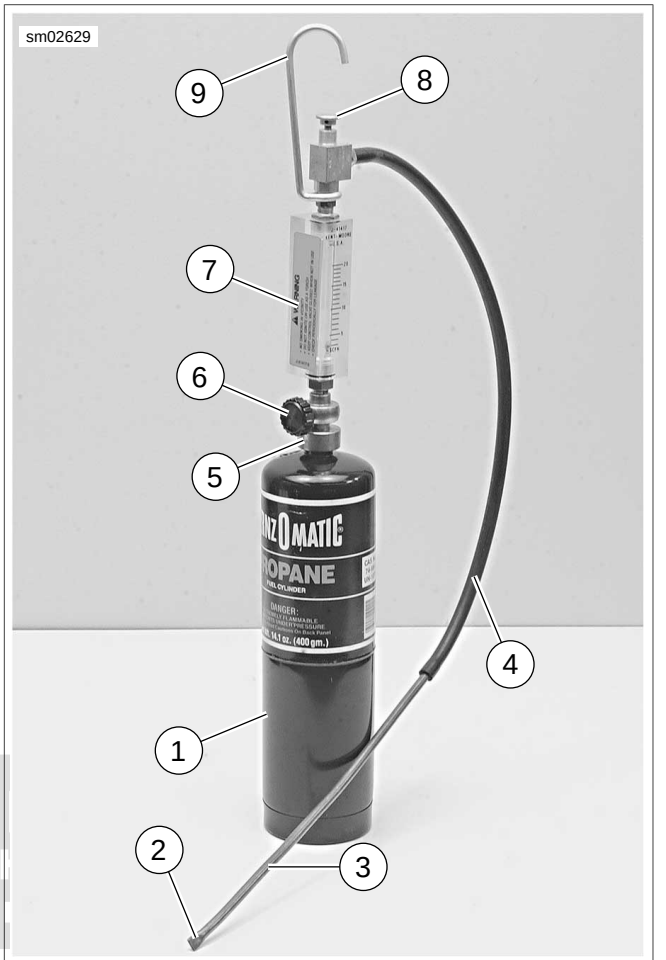
- Standard 14 oz. propane cylinder.
- PROPANE ENRICHMENT KIT (Part No. HD-41417).

Tester Assembly

1. See Figure 4-34. Make sure valve knob (6) is closed (fully clockwise).
2. Screw valve assembly (5) onto propane bottle (1).

Tester Adjustment

1. See Figure 4-34. Press and hold trigger button (8).
2. Slowly open valve knob (6) until pellet in flow gauge (7) rises 5-10 SCFH on gauge.
3. Release trigger button.



1. **Propane bottle**
2. **Nozzle**
3. **Copper tube**
4. **Hose**
5. **Valve assembly**
6. **Valve knob**
7. **Flow gauge**
8. **Trigger button**
9. **Hanger**

Figure 4-34. Leak Tester

PROCEDURE

1. Start engine.
2. Warm up engine to operating temperature.

⚠WARNING

Do not allow open flame or sparks near propane. Propane is extremely flammable, which could cause death or serious injury. (00521b)

NOTE

Do not direct propane stream toward front of engine. If propane enters air horn, a false reading will be obtained.

3. See Figure 4-35. Aim nozzle toward possible sources of leak such as intake manifold mating surfaces.

4. Press and release trigger button to dispense propane. Tone of engine will change when propane enters source of leak. Repeat as necessary to detect leak.
5. When test is finished, close valve knob (turn knob fully clockwise).



Figure 4-35. Checking for Leaks (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

EVAPORATIVE EMISSIONS CONTROL 4.17

GENERAL

Harley-Davidson motorcycles sold in certain markets are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

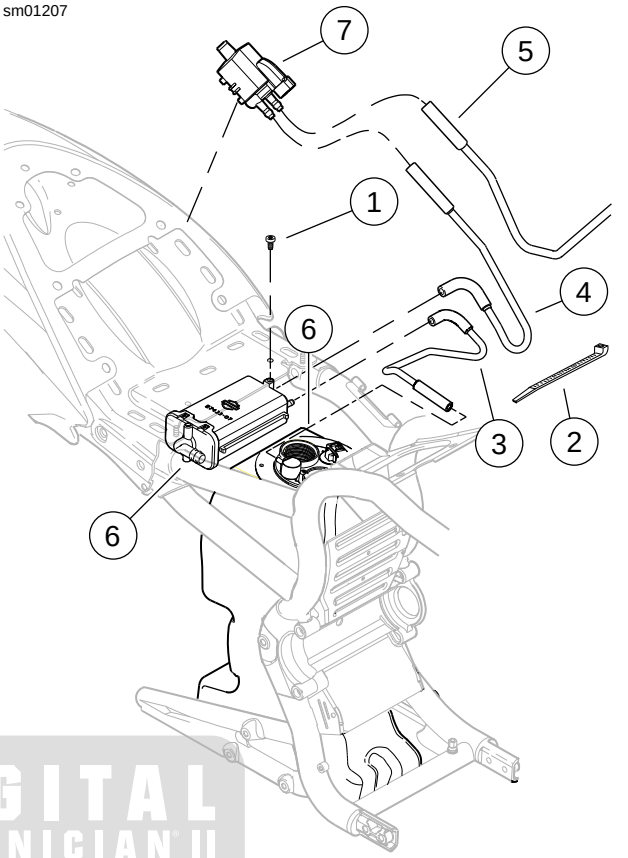
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the carbon canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent tube.
- When the engine is running, intake venturi negative pressure (vacuum) draws off the hydrocarbon vapors from the carbon canister when the purge solenoid is open. These vapors pass through the intake and are burned as part of normal combustion in the engine. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed.

⚠WARNING

Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)

NOTE

The EVAP system has been designed to operate with a minimum of maintenance. Check that all tubes are properly connected, are not pinched or kinked and are routed properly. Improper connections could leak carbon from canister.



1. **Fastener (2)**
2. **Cable Strap**
3. **Tube, vapor valve to canister**
4. **Tube, canister to solenoid**
5. **Tube, solenoid to throttle body**
6. **Carbon canister assembly**
7. **Purge valve solenoid**

Figure 4-36. Evaporative Emissions Control System

PURGE SOLENOID

The purge solenoid allows hydrocarbon vapor flow from the carbon canister to the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed. The power for the solenoid comes from the system relay. The EVMS provides the path to ground to trigger the purge solenoid.

NOTE

Before removing the purge solenoid, perform diagnostics listed in the electrical diagnostic manual.

Removal

1. Remove main fuse. See 7.6 MAIN FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. See Figure 4-36. Press tab on side of electrical caddy and slide purge solenoid (7) free from electrical caddy.
3. Disconnect the wire connector to the purge solenoid.
4. Gently pull off the carbon canister to purge solenoid tube (4).
5. Gently pull off the purge solenoid to throttle body tube (5).

Installation

1. Slide purge valve solenoid (7) onto tab on side of electrical caddy until an audible click is heard.
2. Push on the purge solenoid to throttle body tube (5).
3. Push on the carbon canister to purge solenoid tube (4).
4. Connect wire connector.
5. Install main fuse and right side cover.

CARBON CANISTER

Removal/Inspection

The EVAP carbon canister is mounted under the frame directly in front of the electrical caddy. It can be accessed from under the rider seat.

1. See Figure 4-36. Note tube connections. Gently pull tubes (3, 4, and 5) off carbon canister (6).
2. Remove fasteners (1) and slide carbon canister from under frame.
3. Inspect and replace all tubes, and/or carbon canister as required.

Installation

1. See Figure 4-36. Position **new** carbon canister under frame just in front of electrical caddy and install fasteners and tighten.
2. Attach tubes to canister connections as marked.
3. Install **new** EVAP system label on front frame down tube.

TUBE ROUTING/REPLACEMENT

NOTE

Record location of cable straps before removal. Install cable straps in same location when installing.

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

1. Route purge solenoid tubes.
 a. See Figure 4-36. Attach the purge solenoid to throttle body tube (5) to the throttle body.
 b. Route purge solenoid to throttle body tube (5) under frame tube to purge solenoid (7). Secure with cable straps.
 c. Attach canister to purge solenoid tube (4) to purge solenoid.
 d. Route canister to purge solenoid tube (4) to the carbon canister (6). Attach tube to the fitting marked CARB (1) on left side of canister. Secure with cable straps.
2. Route fuel tank vapor vent tubes.
 a. Route fuel tank vent tube (3) as shown.
 b. Attach short segment of tube to the bottom or short end of the vapor valve and to the fitting marked TANK on carbon canister (6).

DIGITAL TECHNICIAN HARLEY-DAVIDSON

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NOTES

FASTENER TORQUE VALUES 5.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
air bleed plug	9-11 Nm	80-97 **in-lbs**	5.5 THERMOSTAT, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.4 ENGINE COOLANT, Drain and Fill Cooling System
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.6 WATER PUMP, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Bright hose clamp	3-4 Nm	27-35 **in-lbs**	5.6 WATER PUMP, Installation
Clamp and bright clamp	3-4 Nm	27-35 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Cross member fasteners	20-26 Nm	15-19 ft-lbs	5.10 RADIATOR AND OIL COOLER, Installation
ECT sensor	23 Nm	17 ft-lbs	5.8 ENGINE COOLANT TEMPERATURE SENSOR (ECT), Installation
Front and rear oil cooler fasteners	10-12 Nm	89-106 **in-lbs**	5.11 OIL COOLER, Installation
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**	5.4 ENGINE COOLANT, Drain and Fill Cooling System
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**	5.6 WATER PUMP, Removal
Hose clamps	3-4 Nm	27-35 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Hose cover	3-4 Nm	27-35 **in-lbs**	5.6 WATER PUMP, Installation
Oil line fittings	25.5-33.0 Nm	18.8-24.3 ft-lbs	5.9 OIL LINE FITTINGS, Installation
Oil line manifold fasteners	8-10 Nm	71-88 **in-lbs**	5.11 OIL COOLER, Installation
P-clamp	6-10 Nm	53-88 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
P-clamp	6-10 Nm	53-88 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Pipe clamp	6.5 Nm	57 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Pipe clamp	6.5 Nm	57 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Pipe clamp and P-clamp fasteners	6-10 Nm	53-88 **in-lbs**	5.5 THERMOSTAT, Installation
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	5.5 THERMOSTAT, Removal
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	5.6 WATER PUMP, Removal
Radiator mounting nuts	19-27 Nm	14-20 ft-lbs	5.10 RADIATOR AND OIL COOLER, Installation
Radiator oil line bracket fastener	8-10 Nm	71-88 **in-lbs**	5.11 OIL COOLER, Installation
Thermostat housing fasteners	9.7 Nm	86 **in-lbs**	5.5 THERMOSTAT, Installation
Thermostat lower hose clamp	3-4 Nm	27-35 **in-lbs**	5.5 THERMOSTAT, Installation
Water pump mounting bolts	9.7 Nm	86 **in-lbs**	5.6 WATER PUMP, Installation

SPECIFICATIONS: COOLING SYSTEM 5.2

GENERAL

Table 5-1. Capacities

ITEM	LITERS	QUARTS
Engine coolant	2.4	2.54
Engine oil w/filter	4.7	5.0

Table 5-2. Coolant Pressure

ITEM	KPA	PSI
Cap lower limit	96	14
Rated cap pressure	110	16
Cap upper limit	124	18
System pressure	103	15

Table 5-3. Coolant Temperatures

ITEM	°C	°F
Thermostat initially opens	85	185
Thermostat fully open	100	212
Engine temperature lamp	117	243
Antifreeze protection	-36.7	-34

Table 5-4. Fan Operation

STATUS	°C	°F
On	103	217
Off	98	208

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COOLANT FLOW 5.3

GENERAL

⚠WARNING

Coolant mixture contains toxic chemicals, which may be fatal if swallowed. If swallowed, do not induce vomiting; call a physician immediately. Use in a well ventilated area. Irritation to skin or eyes can occur from vapors or direct contact. In case of skin or eye contact, flush thoroughly with water and go to hospital, if necessary. Dispose of used coolant according to federal, state and local regulations. (00092a)

The VRSC engine is cooled by a an ethylene-glycol coolant and the lubricating engine oil.

The ethylene-glycol coolant is pressurized and circulated through the engine and a cooling radiator by an impeller type water pump utilizing a thermostat controlled bypass.

The coolant pressure determines the coolant boiling point. The boiling point rises as the pressure increases and drops as the pressure decreases. At the rated system pressure of 103 kPa (15 psi), the boiling point rises to over 121 °C (250 °F).

The engine oil also cools the engine. Specifically, an oil jet under each piston sprays a mist of oil to lower the operating temperature of that piston. See 3.5 OIL FLOW.

FLOW DESCRIPTION

To warm the engine up quickly, the ethylene-glycol coolant is re-circulated through the cylinders and combustion chamber in the cylinder heads. The thermostat blocks the passage to the radiator to recirculate the coolant.

As coolant exits the pump, it flows through the crankcase and around the cylinder liners removing the heat build-up caused by the motion of the piston rings. From the cylinder liners, the coolant flows up through the cylinder head and around the exhaust valves and combustion chamber. After the coolant passes around the combustion chamber, it then flows back through the closed thermostat into the pump to repeat the cycle. This flow continues until the coolant reaches 85 °C (185 °F) and the thermostat opens.

Once the coolant exceeds 100 °C (212 °F), the thermostat remains open and blocks the by-pass between the entrance and exit ports of the case.

An engine coolant temperature (ECT) sensor is mounted to the thermostat. If the temperature should exceed 117 °C (243 °F), the engine coolant temperature indicator on the instrument cluster will illuminate.

After the coolant leaves the cylinder heads, it flows through the radiator coolant inlet pipe (5) to the radiator. The ethylene-glycol is cooled as it flows through the radiator from left to right.

To increase the amount of air flowing through the radiator, two cooling fans will turn on when the coolant temperature exceeds 103 °C (217 °F) and will turn off when the temperature drops below 98 °C (208 °F).

The coolant exits the top right of the radiator and flows through the radiator outlet coolant pipe to the coolant pump inlet.

The pressure cap and radiator filler neck pressurize the coolant system. When the coolant pressure exceeds the pressure cap lower limit of 96 kPa (14 psi), the lower valve opens and the excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. The overflow bottle is vented to the atmosphere through a long tube which loops over the top of the radiator/oil cooler assembly and down below the coolant level. When the pressure drops, the pressure cap vacuum valve opens to draw coolant back into the coolant inlet pipe from the overflow bottle.

TROUBLESHOOTING

⚠WARNING

The Troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury. (00528b)

Low Engine Temperature

1. Open thermostat.
2. Defective engine coolant sensor.
3. Defective cooling fan.

High Engine Temperature

1. Stuck thermostat.
2. Blocked hoses, pipes or passages.
3. Defective cooling fan.
4. Faulty water pump.
5. Low coolant level.
6. Air in hoses, pipe or passages.
7. Defective pressure cap.
8. Defective engine coolant sensor.
9. Loose triple sprocket fastener

Coolant Leaks

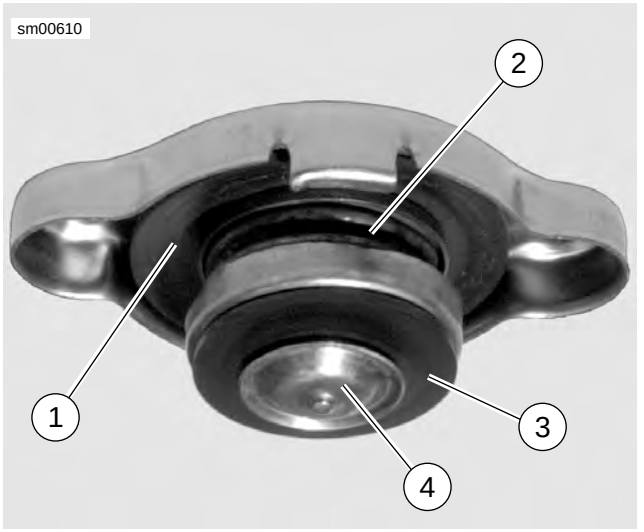
1. Damaged pressure cap gasket.
2. Faulty water pump.
3. Deteriorated O-rings on water pump.
4. Damaged engine gasket.
5. Leaking hose or hose connection.

PRESSURE CAP

The pressure cap and radiator filler neck pressurize the coolant system. The pressure cap's upper spring diaphragm gasket seals to the upper sealing seat in the filler neck. The lower pressure limiting valve in the pressure cap seals to the lower seat. The filler neck has an overflow tube between and upper and lower sealing seat.

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Rising pressure compresses the spring and the lower valve opens. Excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. When the pressure drops, the vacuum valve opens to draw coolant back into the radiator through the overflow tube from the overflow bottle.



1. **Upper sealing gasket**
2. **Spring diaphragm**
3. **Lower sealing gasket**
4. **Vacuum valve**

Figure 5-1. Pressure Cap



1. **Upper sealing seat**
2. **Safety stop**
3. **Cam**
4. **Overflow tube**
5. **Lower sealing seat**

Figure 5-2. Filler Neck (typical)

PRESSURE CAP TEST

PART NUMBER	TOOL NAME
HD-45335	COOLANT SYSTEM PRESSURE TESTER

Test pressure cap for the correct operating range every time the antifreeze is changed or any cooling system maintenance performed.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. See Figure 5-2. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop (2). Let pressure escape. Press down and turn cap to pass over safety stops and remove.
2. Inspect cap for gasket deterioration and inoperative springs.
3. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) tester head and turn pressure cap adapter onto tester head. Turn butterfly valve perpendicular to seal tester head.

NOTE

*To test **new** caps, wet the upper sealing gasket before turning onto adapter.*

4. Turn pressure cap onto adapter. Rotate to safety stops.
5. See Figure 5-3. Pump handle to pressurize pressure limiting valve in cap. Stop pumping when pressure valve in cap opens.
6. Replace pressure cap if:
 a. Leaks below low limit, 96 kPa (14 psi).
 b. Opens above high limit, 124 kPa (18 psi).
 c. Pressure falls rapidly when pressurized within range.
7. Open butterfly valve and remove adaptor and cap.



Figure 5-3. Pressure Cap Test

SYSTEM PRESSURE TEST

PART NUMBER	TOOL NAME
HD-45335	COOLANT SYSTEM PRESSURE TESTER

Pressure test the cooling system to identify a leak and to verify a blown engine gasket.

1. Before troubleshooting cooling system, be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is resting on the jiffy stand.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

2. Using a cloth over pressure cap, turn cap 1/4 turn counter-clockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.

3. See Figure 5-2. Clean and inspect filler neck, upper (1) and lower (5) sealing seats, overflow tube (4), and overflow bottle.

NOTE

Bent filler neck cams and safety stops can cause cap to leak or affect pressure limiting valve. Replace the coolant pipe as required.

4. See Figure 5-4. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) head and turn adapter onto head. Turn butterfly valve perpendicular to seal head to adapter.

NOTE

Wet the upper sealing surfaces before turning adapter onto tester head.

5. Turn double ended pressure cap onto the end of the adapter and onto filler neck. Rotate to the safety stops.

NOTE

When performing the coolant system pressure test, never exceed the upper limit rating of the pressure cap. Excessive pressure can rupture cooling pipes, hoses, and radiator.

6. Pump tester until pressure reaches 103 kPa (15 psi).

7. Refer to Table 5-5. Match movement of needle to system pressure.

8. Release pressure in system by turning butterfly pressure valve perpendicular to head. Wait until pressure is released before removing double ended cap from filler neck.

Table 5-5. System Pressure Test

NEEDLE MOVEMENT	LEAK	ACTION
Holds steady for 2 minutes	None	None
Drops slowly	Small	Dye test
Drops quickly	Major	Visual



Figure 5-4. System Pressure Test (typical)

LEAK DETECTION DYE TEST

PART NUMBER	TOOL NAME
HD-29545-6	COOLANT FLUORESCENT LEAK DETECTION DYE
HD-35457	BLACK LIGHT LEAK DETECTOR

NOTE

If the coolant overflow bottle is empty when the engine is cold, it is possible that air has been drawn into the coolant system. The system must be purged of any trapped air and refilled with coolant.

1. Before troubleshooting cooling system be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is resting on the jiffy stand.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

2. Using a cloth over pressure cap, turn cap 1/4 turn counter-clockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops of filler neck and remove.
3. If filler neck is full of coolant, remove an amount of coolant equal to the amount of dye.
4. See Figure 5-5. Pour COOLANT FLUORESCENT LEAK DETECTION DYE (Part No. HD-29545-6) into filler neck.

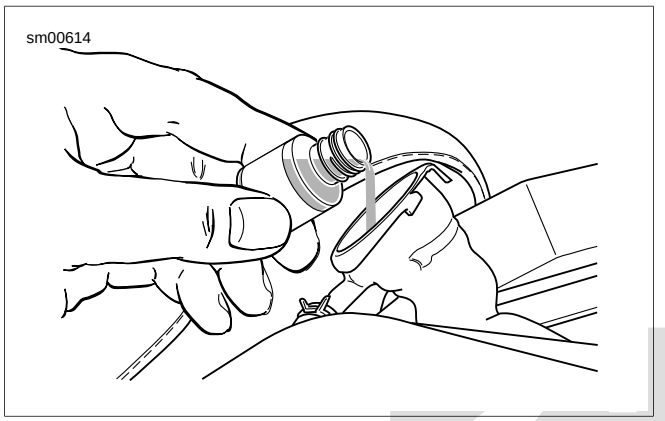


Figure 5-5. Pouring Dye into Filler Neck

5. Install pressure cap and run engine for 10 minutes.
6. Use BLACK LIGHT LEAK DETECTOR (Part No. HD-35457) to illuminate entire cooling system. A yellow fluorescence at any spot indicates a leak.
7. Remove oil dipstick and inspect engine oil for yellow dye.

NOTE

Dye in the oil may indicate a damaged engine head gasket. Draining and replacing coolant contaminated oil will be necessary as part of engine service.

TESTS FOR BLOWN GASKET

PART NUMBER	TOOL NAME
HD-45335	COOLANT SYSTEM PRESSURE TESTER

If a pressure test indicates a leak but there is no visible leak, even after a leak detection dye test, perform the following tests to verify a damaged engine gasket.

1. Start and run cold engine. White smoke from exhaust system indicates a blown gasket.
2. Run engine. Shut off engine.
 a. Remove oil level dipstick. Light colored foam on dipstick indicates a blown gasket.
 b. Open oil drain plug and drain a small amount of oil. Water or coolant will drain out first if gasket is blown.

NOTES

- *Do not allow pressure to build up past the maximum for system. If pressure rises past, turn off engine and turn butterfly pressure valve perpendicular to tester head to release pressure.*
- *Do not continue to run engine unattended with COOLANT SYSTEM PRESSURE TESTER installed. There is no safety valve with the pressure cap removed and the COOLANT SYSTEM PRESSURE TESTER installed.*

3. With COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) installed, start cold engine and idle engine to normal operating temperature.
 a. If gauge indicates fast pressure build up, a gasket is blown.
 b. If pressure does not build up immediately, pump tester to system pressure. If gauge needle vibrates, there is a compression or combustion leak. Disable one spark plug at a time by disconnecting engine harness from coil. The needle will stop vibrating when spark is removed from leaking cylinder.

NOTE

After replacing an engine head gasket, draining and replacing contaminated oil will be necessary as part of engine service.

ENGINE COOLANT 5.4

GENERAL

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE AND COOLANT provides temperature protection to -36.7 °C (-34 °F).

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE AND COOLANT is pre-diluted and ready to use full-strength. DO NOT add water. A mixture of de-ionized water and ethylene glycol-based antifreeze may be used if GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT is unavailable.

NOTE

When temperatures drops below -36.7 °C (-34 °F), a mixture of ethylene glycol-based antifreeze and de-ionized water can be mixed to provide additional protection. Follow the directions on the container of undiluted ethylene glycol to arrive at a percentage mixture that will provide protection for the anticipated temperatures.

DRAIN AND FILL COOLING SYSTEM

PART NUMBER	TOOL NAME
HD-23688	COOLANT TESTER (FAHRENHEIT)
HD-26568	COOLANT TESTER (CELSIUS)

FASTENER	TORQUE VALUE	
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**
Air bleed plug	9-11 Nm	80-97 **in-lbs**

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

⚠WARNING

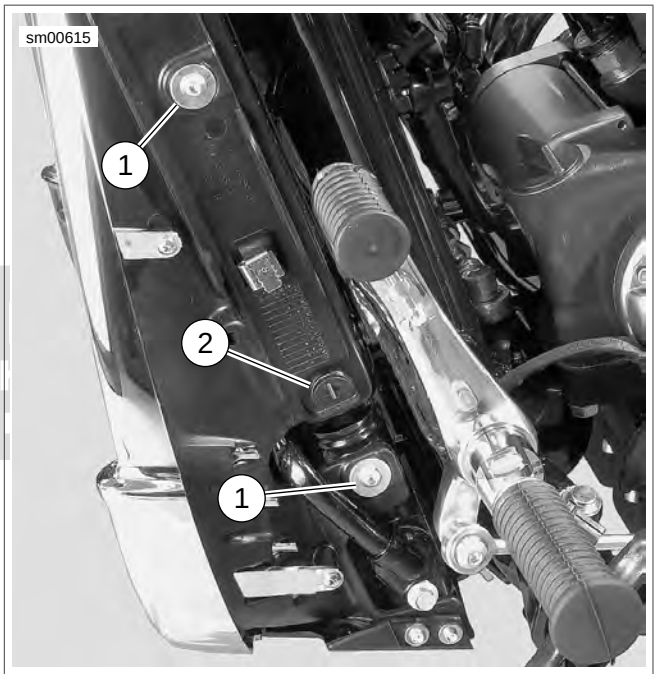
Coolant mixture contains toxic chemicals, which may be fatal if swallowed. If swallowed, do not induce vomiting; call a physician immediately. Use in a well ventilated area. Irritation to skin or eyes can occur from vapors or direct contact. In case of skin or eye contact, flush thoroughly with water and go to hospital, if necessary. Dispose of used coolant according to federal, state and local regulations. (00092a)

1. Allow cooling system to cool.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Open seat. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
4. Use COOLANT TESTER (FAHRENHEIT) (Part No. HD-23688) or COOLANT TESTER (CELSIUS) (Part No. HD-26568) to test coolant protection.
 a. Place a few drips of sample coolant on prism and close cover.
 b. Hold prism up to light and read temperature scale through eye piece.

NOTE

There are several scales visible in eye piece. Read only the temperature scale labeled ethylene-glycol. If the indicated temperature does not meet the rated or required protection for your climate, replace the coolant.

5. Remove air box cover. Remove air filter top, and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.



1. **Radiator cover fastener and washer**
2. **Radiator drain plug**

Figure 5-6. Radiator Left Side (cover removed) (typical) (forward controls model shown)

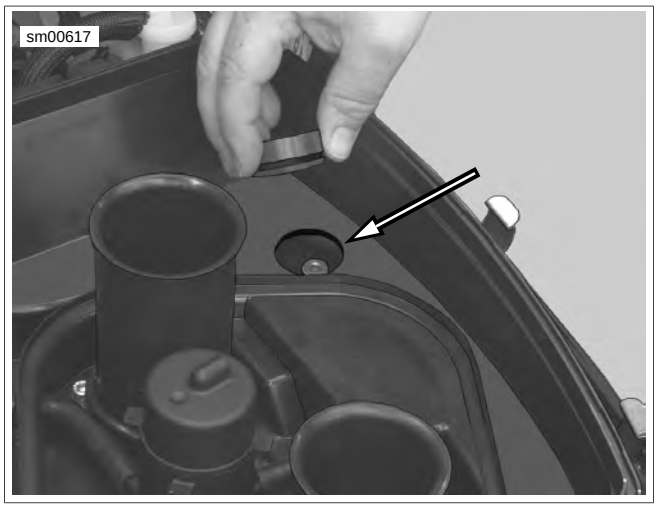


Figure 5-7. Air Bleed Plug

6. See Figure 5-6. Remove left side radiator trim cover. Place a container under engine coolant radiator.

NOTE

Locate dot on coolant drain plug. This indicates location of the drain slot is in drain plug.

7. See Figure 5-8. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container and allow coolant to drain from the radiator.
8. Hand tighten radiator drain plug. Do not overtighten.
9. Place a container under engine and remove front engine coolant drain plug (located directly under front cylinder head). Allow remaining coolant to drain from engine.

NOTE

Dispose of used coolant according to local regulations.

10. Install and tighten front engine coolant drain plug to 9.7 Nm (86 **in-lbs**).
11. Install radiator trim cover.

NOTICE

De-ionized water must be used with the antifreeze in the cooling system. Hard water can cause scale accumulation in water passages which reduces cooling system efficiency, leading to overheating and engine damage. (00195a)

12. See Figure 5-7. Loosen air bleed plug.
13. Through the filler neck, fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT up to lower sealing surface in filler neck.
14. Install pressure cap and tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**).
15. Install air filter, air filter top, and air box cover.
16. Install main fuse and side cover.
17. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle resting on jiffy stand. If level is below COLD FULL line, add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT to overflow bottle until fluid level reaches COLD FULL line.
18. Continue to run engine, check level, and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level remains at COLD FULL line with motorcycle resting on jiffy stand.



Figure 5-8. Slot in Radiator Drain Plug

THERMOSTAT 5.5

GENERAL

The thermostat is a valve that remains closed until the engine reaches operating temperature. When the coolant temperature exceeds 85 °C (185 °F), the thermostat opens allowing engine coolant to flow out of the engine to the radiator. The thermostat is fully open at 100 °C (212 °F).

REMOVAL

PART NUMBER	TOOL NAME
HD-45307	THERMOSTAT REMOVAL TOOL

FASTENER	TORQUE VALUE	
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system and engine to cool.
2. Remove right side cover and main fuse.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen radiator drain plug and orient slot in drain plug to drain engine coolant into suitable container. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTE

Dispose of used coolant according to local regulations.

6. Hand tighten radiator drain plug. Do not overtighten.

NOTE

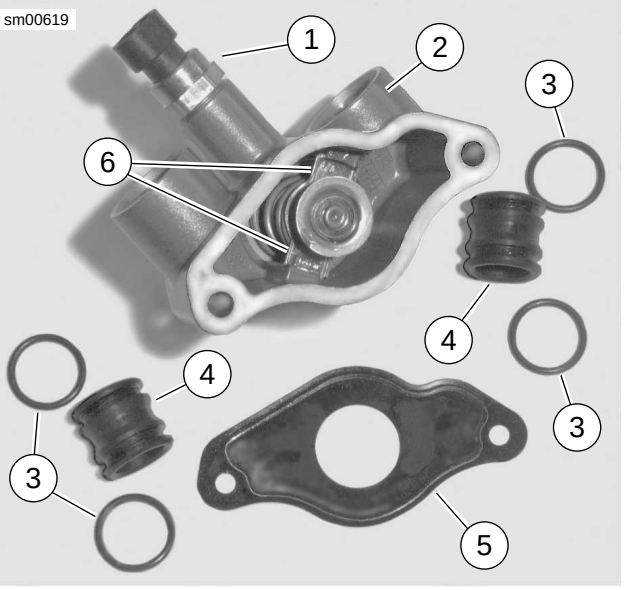
*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**).*

7. Remove air filter cover, air filter top, air filter, breather hose, velocity stacks, and air filter bottom. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
8. Remove pipe clamp and P-clamp from coolant pipes.
9. Loosen lower clamp on hose to engine coolant pipe. Pull coolant outlet pipe and hose up.
10. Remove fasteners and lockwashers holding housing to engine case. Remove thermostat housing.
11. See Figure 5-9. Disconnect coolant temperature sensor (1) from wiring harness.

NOTE

See Figure 5-9. The engine coolant temperature sensor (1) threads into the engine side of the thermostat housing.

12. Pull thermostat tubes (4) and O-rings (3) out of engine.
13. See Figure 5-10. To remove thermostat from housing, engage tabs on thermostat with slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307).
14. Press on end of tool to compress thermostat spring while turning tool 90 degrees counterclockwise (CCW). Remove thermostat.



1. **Engine coolant temperature sensor**
2. **Thermostat housing**
3. **O-ring**
4. **Thermostat tube**
5. **Gasket**
6. **Tabs**

Figure 5-9. Thermostat and Housing

INSTALLATION

PART NUMBER	TOOL NAME
HD-45307	THERMOSTAT REMOVAL TOOL

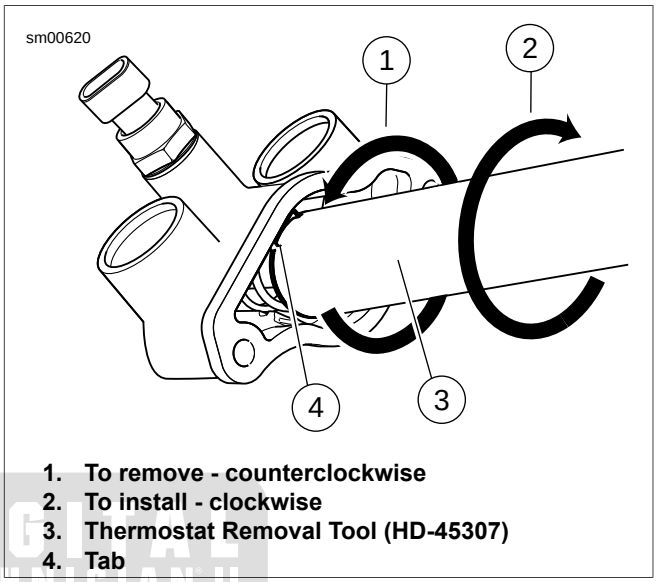
FASTENER	TORQUE VALUE	
Thermostat housing fasteners	9.7 Nm	86 **in-lbs**
Thermostat lower hose clamp	3-4 Nm	27-35 **in-lbs**
Pipe clamp and P-clamp fasteners	6-10 Nm	53-88 **in-lbs**
air bleed plug	9-11 Nm	80-97 **in-lbs**

1. See Figure 5-10. To install **new** thermostat into housing, engage slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307) into tabs of thermostat while compressing thermostat spring. Turn tool 90 degrees clockwise (CW) to lock thermostat into housing.

NOTE

*Lubricate **new** components with engine coolant to ease assembly.*

2. See Figure 5-9. With **new** O-rings (3) on thermostat tubes (4), push tubes into engine case.
3. Connect engine coolant temperature sensor (1) to wiring harness.
4. Be sure lower clamp is in place on hose to engine coolant pipe.
5. Orient **new** thermostat housing gasket (5) to mating surface on engine case.
6. Push housing pipe into pipe hose and over thermostat tubes (4). Fit housing (2) to engine case.
7. Thread in housing fasteners and tighten to 9.7 Nm (86 **in-lbs**).
8. With lower hose clamp in correct orientation, tighten clamp to 3-4 Nm (27-35 **in-lbs**).
9. Install pipe clamp and P-clamp. Tighten fasteners to 6-10 Nm (53-88 **in-lbs**).
10. Install air filter bottom, velocity stacks, O-rings and breather hose. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
11. Loosen air bleed plug. Remove pressure cap and fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and install pressure cap.
13. Install air filter components.
14. Install main fuse and side cover.
15. Rinse the motorcycle with water to remove any spilled coolant.
16. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle resting on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level reaches COLD FULL line.
17. Continue to run engine, check level, and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until coolant level remains at COLD FULL line with the motorcycle resting on the jiffy stand.
18. Install airbox cover.



1. **To remove - counterclockwise**
2. **To install - clockwise**
3. **Thermostat Removal Tool (HD-45307)**
4. **Tab**

Figure 5-10. Thermostat Removal Tool

DIGITAL TECHNICIAN II HARLEY-DAVIDSON®

WATER PUMP 5.6

REMOVAL

FASTENER	TORQUE VALUE	
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen and orient slot in radiator plug to drain engine coolant into suitable container.
6. Place a suitable container under engine and remove front engine coolant drain plug to drain coolant from engine.

NOTE

Dispose of used coolant according to local regulations.

7. Hand tighten radiator drain plug. Do not overtighten.

NOTE

*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**).*

8. Install and tighten front engine coolant drain plug to 9.7 Nm (86 **in-lbs**).
9. Install left side radiator trim cover.
10. Remove air box cover. Remove air filter top and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
11. Remove pipe clamp and P-clamp from coolant pipes. See 5.7 COOLANT PIPES AND HOSES.
12. Remove hose cover clamp from upper end of hose to coolant pipe and loosen lower hose clamp. Pull coolant pipe up.
13. See Figure 5-11. Remove water pump bolts and remove water pump cover.
14. Remove the insert.
15. See Figure 5-12. Using a soft mallet, tap on side of water pump to loosen.
16. See Figure 5-13. Remove bearing housing assembly with the O-rings and gasket.



Figure 5-11. Removing Cover



Figure 5-12. Removing Water Pump (clutch cover removed for clarity)

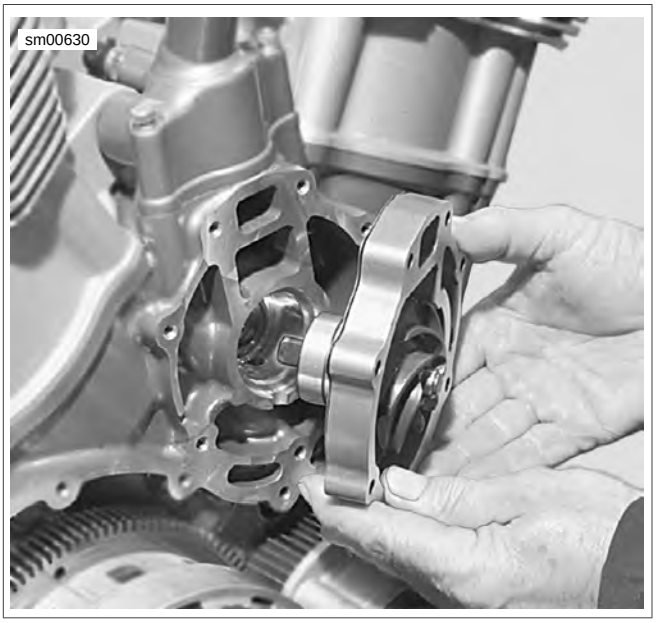


Figure 5-13. Water Pump Bearing Housing Assembly (clutch cover removed for clarity)

INSTALLATION

FASTENER	TORQUE VALUE	
Water pump mounting bolts	9.7 Nm	86 **in-lbs**
Bright hose clamp	3-4 Nm	27-35 **in-lbs**
Hose cover	3-4 Nm	27-35 **in-lbs**
Air bleed plug	9-11 Nm	80-97 **in-lbs**

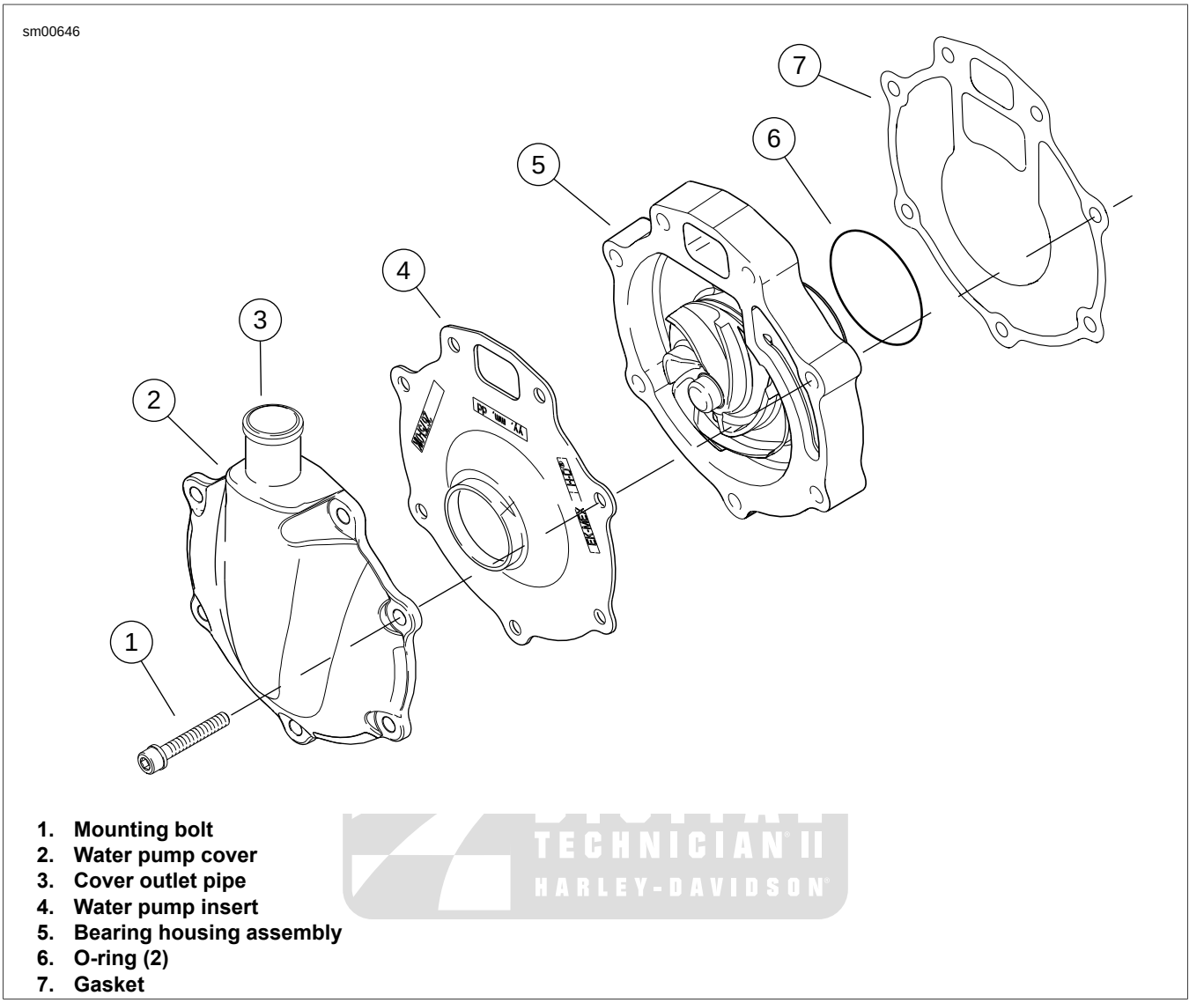
1. Clean engine cavity.
2. See Figure 5-14. Lube and install **new** O-ring (6) on bearing housing assembly (5).
3. Install **new** gasket (7) with part numbers facing away from engine crankcase.
4. Align pump square drive with drive shaft and push water pump into engine cavity.

NOTE

Use a lubricant such as tire soap or detergent and water to lubricate the hose to aid in pushing hose over neck beads.

5. Install water pump insert (4) and water pump cover (2) and secure with mounting bolts (1).
6. Tighten water pump mounting bolts to 9.7 Nm (86 **in-lbs**).
7. Push pump-to-engine coolant pipe hose on cover outlet pipe (3).
8. Install lower bright hose clamp and tighten to 3-4 Nm (27-35 **in-lbs**).
9. Install and tighten hose cover to 3-4 Nm (27-35 **in-lbs**).
10. Install pipe clamp and P-clamp. See 5.7 COOLANT PIPES AND HOSES.
11. Loosen air bleed plug. Fill with **new** GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and install pressure cap.
13. Install main fuse and right side cover.
14. Rinse motorcycle with water to remove any spilled coolant.
15. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle resting on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level reaches COLD FULL line.
16. Continue to run engine, check level, and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level remains at COLD FULL line with motorcycle resting on jiffy stand.
17. Install airbox cover.

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1. **Mounting bolt**
2. **Water pump cover**
3. **Cover outlet pipe**
4. **Water pump insert**
5. **Bearing housing assembly**
6. **O-ring (2)**
7. **Gasket**

TECHNICIAN II
HARLEY-DAVIDSON

Figure 5-14. Water Pump

COOLANT PIPES AND HOSES 5.7

REMOVAL

PART NUMBER	TOOL NAME
SNAP-ON SDD1410	SCREWDRIVER

1. Allow cooling system to cool.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover. Remove radiator plug and drain engine coolant into suitable container.

NOTE

Dispose of used coolant according to local regulations.

5. Remove air filter top, air filter, breather hose, velocity stacks and air filter bottom. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
6. See Figure 5-15. Loosen pipe clamp (4). Loosen and remove fastener (7) holding P-clamp (8) to engine.
7. Squeeze clamp (17) and pull off end of overflow hose at overflow bottle. Pull drain hose to radiator/oil cooler off overflow bottle. Remove overflow bottle.
8. Loosen clamps (12, 17) on bottom of hoses to water pump and thermostat.
9. Use a long thin SCREWDRIVER (Part No. Snap-on SDD1410) to loosen clamps (12) and pull hoses (10, 13) off radiator.
10. Remove engine coolant pipes (2, 3) with hoses (10, 13, 15, 18, and 20).

DISASSEMBLY

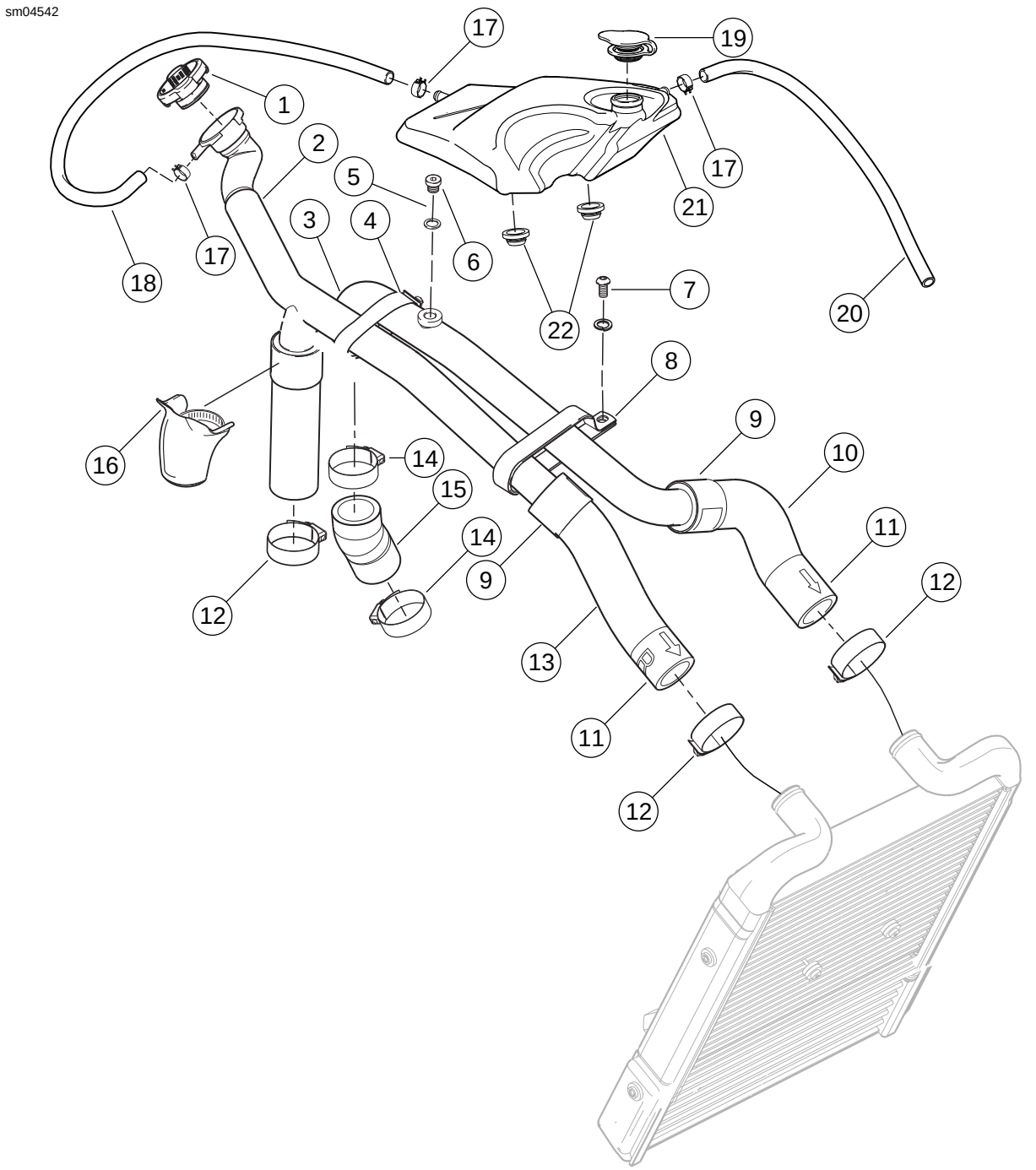
1. See Figure 5-15. Cut shrink clamps (9) from the coolant inlet and the coolant outlet pipes (2, 3) and hoses (10, 13, 19).

NOTE

To remove shrink clamps without cutting, use a soldering iron and carefully melt a slice through the band without damaging the hose.

2. Loosen overflow hose clamp (17) and remove overflow hose (18) from filler neck.
3. Remove hose cover (16) and loosen upper clamp (14) from the water pump to coolant inlet pipe hose.
4. Clean hose mounting stems on the engine coolant inlet pipe (2) and the engine coolant outlet pipe (3) with a wire brush.
5. Inspect all components and replace as required.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Pressure cap
2. Coolant inlet pipe
3. Coolant outlet pipe
4. Pipe clamp
5. Air bleed plug
6. Seal
7. Fastener and washer
8. P-clamp
9. Shrink clamp (2)
10. Hose (engine coolant outlet pipe to radiator)
11. Embossed arrow - top and front
12. Clamp - bright
13. Hose - coolant inlet pipe to radiator
14. Clamp - black (2)
15. Hose
16. Hose cover
17. Clamp - overflow hose
18. Overflow hose
19. Cap
20. Breather hose
21. Coolant bottle
22. Coolant bottle to frame mounting grommets

Figure 5-15. Coolant Pipes, Hoses and Overflow Bottle

ASSEMBLY

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN

1. See Figure 5-15. If removed, thread the air bleed plug (5) with **new** seal (6) into the coolant outlet pipe (3).
2. Remove **new** shrink clamp (9) from packaging brace by squeezing band to collapse, then fold in half and remove from cardboard. Slide shrink clamps over hoses.
3. Orient radiator hoses with embossed arrow (11) on top and towards front. Push hose over fitting beads on coolant inlet and coolant outlet pipes (2, 3).
4. Orient shrink clamps (9) so print on the clamp is visible after shrinking. Slide clamp over end of hose to overlap the bulge formed by fitting bead of coolant pipe.

NOTE

Do NOT use open flame to shrink clamp. Using an open flame could result in uncontrolled melting of clamp.

5. Using a ROBINAIR HEAT GUN (Part No. HD-25070) or similar tool, apply heat to shrink clamps (9). Move heat tool around clamp continuously to prevent burning.

NOTE

Heated area must cover at least 1/3 of clamp surface. If heating shrink clamp while hose and pipe are still mounted in motorcycle, take care not to damage surrounding components.

6. Heat until shrink wrap contracts and remove heat.

NOTE

Check seal by trying to rotate hose on fitting by hand. Hose and clamp should NOT turn when using reasonable torque.

7. Repeat for each shrink clamp required.

INSTALLATION

PART NUMBER	TOOL NAME
SNAP-ON SDD1410	SCREWDRIVER

FASTENER	TORQUE VALUE	
Clamp and bright clamp	3-4 Nm	27-35 **in-lbs**
Pipe clamp	6.5 Nm	57 **in-lbs**
P-clamp	6-10 Nm	53-88 **in-lbs**
Air bleed plug	9-11 Nm	80-97 **in-lbs**

1. See Figure 5-15. With upper black clamp (14) on hose (15) and lower black clamp (14) loose, install coolant outlet pipe (3).
2. With embossed arrow (11) pointing towards front and on top, push hose (10) over neck bead of radiator inlet neck. Push hose (15) onto outlet neck of thermostat housing.

NOTE

Use a lubricant such as tire soap or detergent and water to lubricate the hose to aid in pushing hose over neck beads.

3. With hose cover (16), clamp (14), and bright clamp (12) loose on hose, install coolant inlet pipe (2).
4. With embossed arrow (11) pointing towards front and on top, push hose (13) over neck bead of radiator outlet and push hose (20) over water pump inlet neck.
5. Use a long thin SCREWDRIVER (Part No. SNAP-ON SDD1410) to tighten clamps (12, 14) to 3-4 Nm (27-35 **in-lbs**).
6. Install P-clamp (8) and pipe clamp (4) over both pipes. Tighten pipe clamp (4) to 6.5 Nm (57 **in-lbs**) and tighten P-clamp to 6-10 Nm (53-88 **in-lbs**).
7. Install overflow bottle with overflow hose and cap (19) to grommets on frame.
8. Install and clamp overflow hose to filler neck and overflow bottle.
9. Pressure test to 103 kPa (15 psi).
10. Install air filter bottom, velocity stacks, O-rings, and breather hose. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and install pressure cap.
13. Install air filter and air filter top.
14. Install right side cover and main fuse.
15. Rinse motorcycle with water to remove any spilled coolant.
16. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle resting on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level reaches COLD FULL line.
17. Continue to run engine, check level with motorcycle resting on jiffy stand, and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level remains at COLD FULL line.
18. Install air box cover.

DIGITAL TECHNICIAN HARLEY-DAVIDSON

ENGINE COOLANT TEMPERATURE SENSOR (ECT) 5.8

GENERAL

Refer to electrical diagnostic manual for information on the function and testing of the engine coolant temperature (ECT) sensor.

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove air box assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
3. Remove horn. See 7.26 HORN.
4. Remove front engine drain plug. Drain cooling system. See 5.4 ENGINE COOLANT.
5. Unplug ECT sensor connector [90B] by pulling external latch outward and using rocking motion to remove.
6. Loosen ECT sensor using socket. When sensor starts to turn easily, finish removing by hand.

INSTALLATION

FASTENER	TORQUE VALUE	
ECT sensor	23 Nm	17 ft-lbs

1. Hand-start **new** ECT sensor into thermostat housing 2-3 turns.
2. Tighten sensor to 23 Nm (17 ft-lbs).
3. Connect ECT sensor connector [90B].
4. Install horn. See 7.26 HORN.
5. Fill engine coolant system with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT. See 5.4 ENGINE COOLANT.
6. Install air filter components. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
7. Install the main fuse. See 7.6 MAIN FUSE.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

OIL LINE FITTINGS 5.9

REMOVAL

PART NUMBER	TOOL NAME
HD-46503	OIL LINE REMOVER

1. Allow cooling system to cool.
2. Remove right side cover and main fuse.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Remove negative battery cable.
4. Snap the plastic dust cap from the quick connect oil line fitting at the crankcase (oil in) and slide it up the oil pipe.

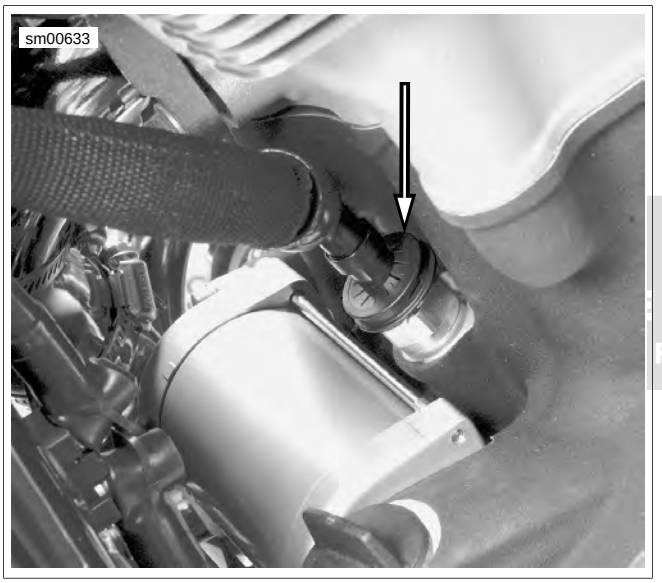


Figure 5-16. Crankcase Oil Line (oil in) Fitting

5. See Figure 5-17. Close the OIL LINE REMOVER (Part No. HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
6. See Figure 5-18. Rotate the tool to expand the spring clip out of the groove in the oil fitting.

NOTE

Place a container under fitting to catch oil drips.

7. Hold oil line remover and pull the oil line and the tool from the fitting.
8. Repeat to remove the oil line from the remaining oil line fitting.
9. Remove oil line fittings and plug the holes until they can be replaced.
10. Remove fasteners securing radiator/oil cooler assembly. See 5.10 RADIATOR AND OIL COOLER.
11. Supporting the radiator/oil cooler assembly, pull the assembly far enough forward to access the oil filter (oil out) fitting.
12. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter.
13. Use the OIL LINE REMOVER (Part No. HD-46503) to remove the oil line from the fitting.
14. Remove the radiator/oil cooler assembly from the motorcycle.



Figure 5-17. Oil Line Remover



Figure 5-18. Oil Line Fitting with Spring Clip

INSTALLATION

FASTENER	TORQUE VALUE	
Oil line fittings	25.5-33.0 Nm	18.8-24.3 ft-lbs

1. Install oil line fittings with O-ring into crankcase (oil in) and oil filter mount (oil out). Tighten to 25.5-33.0 Nm (18.8-24.3 ft-lbs).
2. See Figure 5-19. Supporting the radiator/oil cooler assembly, push the flanged oil line into the oil filter (oil out) fitting until it clicks in place under the spring clip.
3. Snap the plastic dust cap over the spring clip groove.
4. Install the radiator/oil cooler assembly. See 5.10 RADIATOR AND OIL COOLER.
5. Push the flanged oil line into the crankcase (oil in) fitting until it clicks in place under the spring clip.

NOTE

If the yellow witness band on the flanged oil line is visible, the oil line is not correctly snapped into the fitting.

6. Snap the plastic dust cap over the spring clip groove.

NOTE

Dust cap will not snap onto fitting if the oil line is not correctly installed on fitting.

7. Lightly tug on oil line to verify that it is securely locked to fitting.
8. Check oil level and add oil if required.
9. Install main fuse and right side cover.
10. After running engine,
 a. Inspect oil fittings for oil leaks.
 b. Check oil level and add oil if required.



Figure 5-19. Flanged Oil Line

RADIATOR AND OIL COOLER 5.10

GENERAL

NOTICE

Clean the inlet surface of the radiator regularly. Leaves and other debris can collect on the radiator surface and degrade radiator performance which could lead to engine overheating and engine damage. (00197c)

The heat exchangers, or radiators, for both engine cooling and oil cooling are bolted together in a single radiator/oil cooler assembly. The radiator/oil cooler assembly is fastened to the frame with:

- Double threaded studs near the steering head.
- Two pins and rubber grommets on the bottom of the oil cooler that fit the frame cross member.

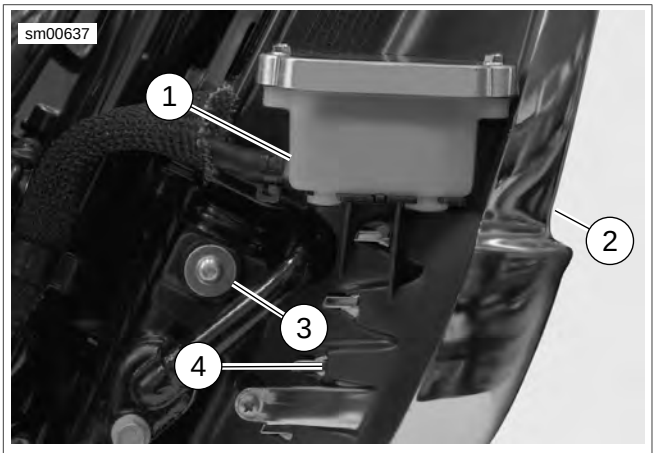
REMOVAL

PART NUMBER	TOOL NAME
HD-46503	OIL LINE REMOVER
SNAP-ON SDD1410	LONG THIN SCREWDRIVER

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and main fuse.
3. Remove air box decorative cover, air box cover, air filter cover and air filter. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
4. See Figure 5-22. Remove fastener and right radiator trim cover.
5. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.



1. **Rear brake master cylinder reservoir**
2. **Chrome inlet bezel**
3. **Fastener and washer**
4. **Radiator cover**

Figure 5-20. Right Side Radiator

6. See Figure 5-22. Remove fastener and left radiator trim cover.

NOTE

Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

7. Remove cable strap securing cooling fan wire harness to crankshaft position sensor (CKP) harness.
8. Remove cable strap securing clutch line and harness to oil line.
9. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
10. Push connectors and wire harnesses away from coolant drain plug up and behind shift lever.
11. Place a container under left side of radiator.



Figure 5-21. Dot on Coolant Drain Plug

NOTE

Locate dot on coolant drain plug. This indicates location of the drain slot in drain plug.

12. See Figure 5-22. Loosen but do not remove coolant drain plug (3). Turn drain plug until slot in threads drains into container.
13. Open seat and remove pressure cap to accelerate coolant drain from radiator.
14. Hand-tighten coolant drain plug. See 5.4 ENGINE COOLANT.

NOTE

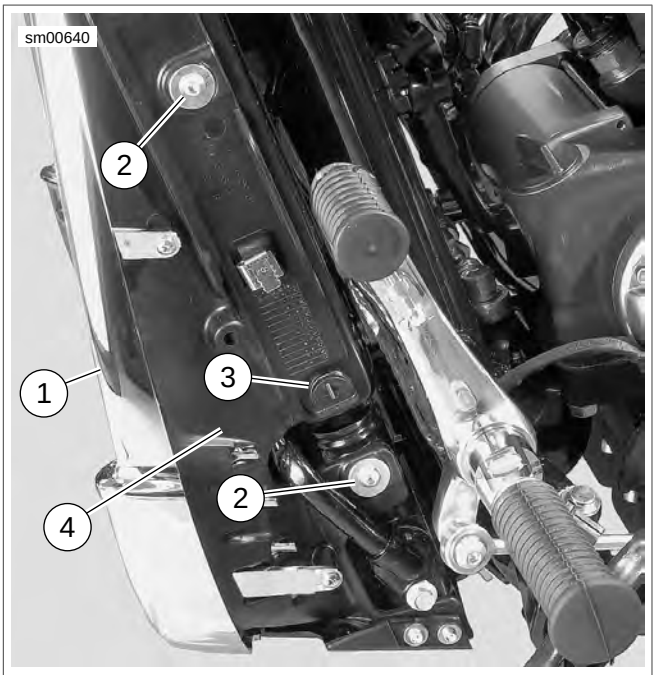
Dispose of used coolant in accordance with local regulations.

15. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Install dipstick and drain plug. See 1.6 ENGINE OIL AND FILTER.

NOTE

Dispose of used oil in accordance with local regulations.

16. Separate connectors [47] and [77] from voltage regulator.
17. Remove top cooling fan connector [97T] from radiator cover by rocking first one way and with a finger pull the connector tab to compress butterfly peg.
18. Separate top cooling fan wiring harness connector [97T] and bottom cooling fan connector [97B].
19. Separate crank position sensor connector [79].
20. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with inlet bezels attached.
21. Remove cable strap securing regulator harness to oil line.



1. **Chrome inlet bezel**
2. **Fastener and washer**
3. **Coolant drain plug**
4. **Radiator cover**

Figure 5-22. Left Side Radiator (typical) (forward controls model shown)

NOTE

Both the oil line lines to the oil cooler remain fastened to the radiator/oil cooler assembly. The drain hose from the expansion bottle also remains clipped to the assembly.

22. Use a LONG THIN SCREWDRIVER (Part No. SNAP-ON SDD1410) to loosen worm drive clamps on both engine coolant hoses at radiator.
23. See Figure 5-23. Loosen but do not remove nuts holding assembly to front engine mount studs.
24. Remove fasteners under radiator assembly that hold cross member to frame. Gently pull bottom of radiator/oil cooler assembly forward.
25. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter (oil out).
26. See Figure 5-17. Close the OIL LINE REMOVER (Part No. HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
27. See Figure 5-18. Holding the oil line in the palm of the hand, rotate the tool to expand the spring clip out of the groove in the oil fitting.
28. With a cup under the fitting, use finger and thumb to hold the OIL LINE REMOVER (Part No. HD-46503) squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent pulling the line and tool from the fitting simultaneously.

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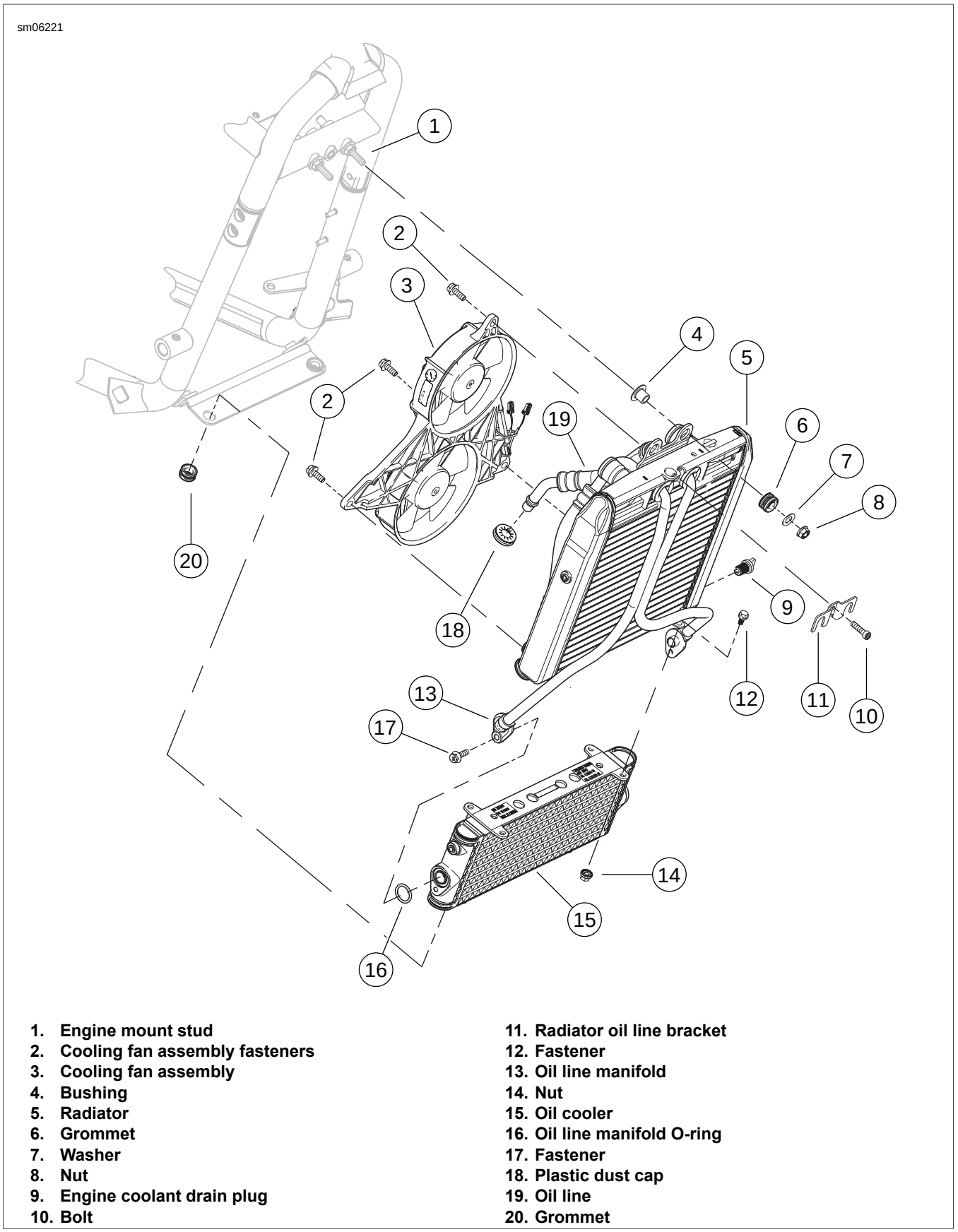
29. Pull the oil line and the tool from the fitting.
30. Repeat to remove the oil line from the crankcase (oil in) oil line fitting. See 5.9 OIL LINE FITTINGS.
31. Remove nuts holding radiator assembly to engine mount studs and remove radiator/oil cooler assembly.
32. Retain bushings, grommets and washers.

INSTALLATION

FASTENER	TORQUE VALUE	
Cross member fasteners	20-26 Nm	15-19 ft-lbs
Radiator mounting nuts	19-27 Nm	14-20 ft-lbs
Pipe clamp	6.5 Nm	57 **in-lbs**
P-clamp	6-10 Nm	53-88 **in-lbs**
Hose clamps	3-4 Nm	27-35 **in-lbs**
Air bleed plug	9-11 Nm	80-97 **in-lbs**

1. Cover front fender with a shop towel or protective cover.
2. Hold radiator/oil cooler assembly up to frame.
3. Line up and fit inlet and outlet pipes to radiator hoses.
4. Push oil line into oil out fitting on oil filter. Snap plastic ring around spring clip groove on fitting. See 5.9 OIL LINE FITTINGS.
5. Thread on but do not tighten nuts holding radiator/oil cooler assembly to engine mount studs.
6. Push oil line into oil in fitting on crankcase. Snap plastic ring around spring clip groove on fitting. See 5.9 OIL LINE FITTINGS.
7. See Figure 5-23. Slip grommets (20) into cross member on frame. Install radiator into cross member on frame.
8. Tighten cooling system fasteners to following:
 a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
 b. Radiator mounting nuts (8) to 19-27 Nm (14-20 ft-lbs).
 c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
 d. P-clamp to 6-10 Nm (53-88 **in-lbs**).
 e. Hose clamps to 3-4 Nm (27-35 **in-lbs**).
9. Install cable strap securing regulator harness to oil line.
10. Install radiator cover.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. Engine mount stud
2. Cooling fan assembly fasteners
3. Cooling fan assembly
4. Bushing
5. Radiator
6. Grommet
7. Washer
8. Nut
9. Engine coolant drain plug
10. Bolt
11. Radiator oil line bracket
12. Fastener
13. Oil line manifold
14. Nut
15. Oil cooler
16. Oil line manifold O-ring
17. Fastener
18. Plastic dust cap
19. Oil line
20. Grommet

Figure 5-23. Radiator/Oil Cooler Assembly (typical)

11. Mate:
 a. Crank position sensor connector [79] halves.
 b. Top and bottom cooling fan connector [97T], [97B] halves.
 c. Connectors [47] and [77] to voltage regulator.
12. Push top fan connector [97T] into radiator cover.
13. Secure fan wiring harness to crank position sensor wiring harness and mount both through frame clip with cable strap.
14. Install cable strap securing clutch line and harness to oil line.
15. Install left and right side radiator covers.
16. Fill engine with oil. See 1.6 ENGINE OIL AND FILTER.
17. Install air filter bottom, velocity stacks, O-rings and breather hose. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
18. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT through filler neck. See 5.4 ENGINE COOLANT.
19. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and install pressure cap.
20. Install air filter and air filter top. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
21. Install main fuse and right side cover.
22. After running engine, inspect oil fittings for oil leaks. Check oil level and add oil if required.
23. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle resting on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level reaches COLD FULL line.
24. Continue to run engine, check level, and add GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE AND COOLANT until fluid level remains at COLD FULL line with motorcycle resting on jiffy stand.
25. Install air filter cover.

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OIL COOLER 5.11

REMOVAL

1. Allow cooling system to cool.
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Remove oil lines from oil fittings. See 5.9 OIL LINE FITTINGS.
4. Remove the radiator/oil cooler assembly. See 5.10 RADIATOR AND OIL COOLER.
5. See Figure 5-23. With assembly on bench and holding a cup under each line, remove the fasteners holding oil line manifolds to oil cooler. Discard O-rings.

NOTE

If replacing oil lines, remove oil line bracket fastener and bracket with spacers bushings, grommets and washers.

6. Remove fasteners holding oil cooler to engine coolant radiator. Remove oil cooler.

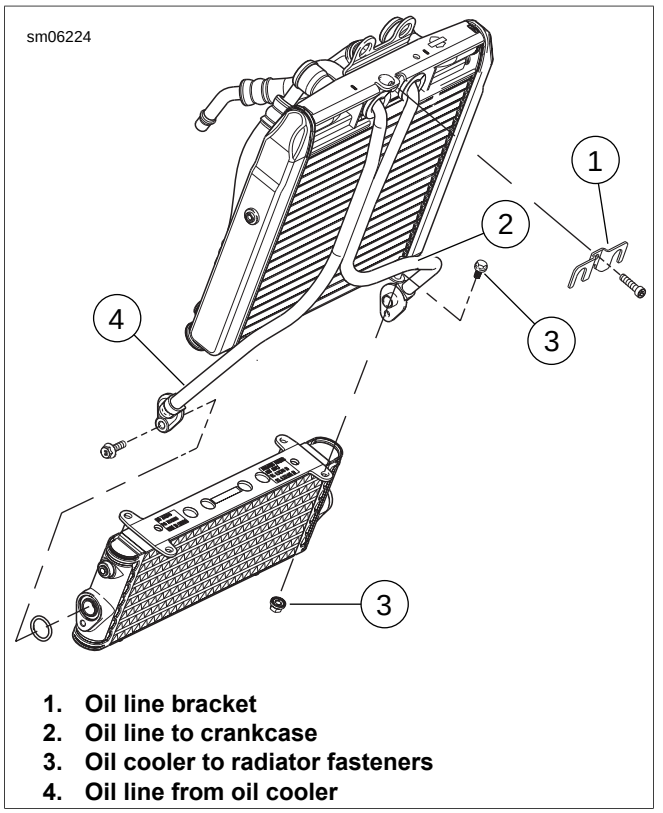


Figure 5-24. Oil Line Manifold

INSTALLATION

FASTENER	TORQUE VALUE	
Front and rear oil cooler fasteners	10-12 Nm	89-106 **in-lbs**
Radiator oil line bracket fastener	8-10 Nm	71-88 **in-lbs**
Oil line manifold fasteners	8-10 Nm	71-88 **in-lbs**

1. See Figure 5-25. Install oil cooler to engine coolant radiator. Tighten front and rear fasteners (3) to 10-12 Nm (89-106 **in-lbs**).
2. If installing oil pipes:
 a. Route oil pipes in front and over top of engine coolant radiator.
 b. Install radiator oil line bracket (1) over the oil lines and tighten fastener to 8-10 Nm (71-88 **in-lbs**).
 c. Install **new** O-rings in the oil cooler ports.
 d. Install fasteners holding oil line manifolds to oil cooler. Tighten to 8-10 Nm (71-88 **in-lbs**).
 e. See Figure 5-23. Install spacer, bushings grommet, and washers to radiator/oil cooler assembly mounting bracket.
3. Install the radiator/oil cooler assembly. See 5.10 RADIATOR AND OIL COOLER.
4. Install main fuse and right side cover.
5. After running engine, check oil and coolant levels. See 5.10 RADIATOR AND OIL COOLER



1. **Oil line bracket**
2. **Oil line to crankcase**
3. **Oil cooler to radiator fasteners**
4. **Oil line from oil cooler**

Figure 5-25. Radiator and Oil Cooler Assembly

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NOTES

FASTENER TORQUE VALUES 6.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs	6.5 COUNTERBALANCER BEARING REPLACEMENT, Installation
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs	6.4 TRANSMISSION, Assembly
* Main bearing bolts; first torque then loosen one turn	25 Nm	18.4 ft-lbs	6.4 TRANSMISSION, Assembly/Loosen one full turn then final tighten.
* Main bearing bolts; second torque plus 90 degrees	15 Nm	131 **in-lbs**	6.4 TRANSMISSION, Assembly/Tighten to specification plus an additional 90 degrees
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**	6.9 DRIVE BELT, Replacement
Clutch hub nut	220 Nm	162 ft-lbs	6.3 CLUTCH, Installation
Clutch side crankcase cover fasteners	9.7 Nm	86 **in-lbs**	6.3 CLUTCH, Installation
Crankcase/transmission case fasteners	25 Nm	18.4 ft-lbs	6.4 TRANSMISSION, Assembly
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	6.9 DRIVE BELT, Replacement
Drive sprocket flange nut	160 Nm	118 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	6.4 TRANSMISSION, Assembly
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Flange nut, drive sprocket	160 Nm	118 ft-lbs	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
Input bearing retainer fasteners	23 Nm	17 ft-lbs	6.4 TRANSMISSION, Assembly
Locking bolts	88-102 Nm	65-75 ft-lbs	6.9 DRIVE BELT, Replacement
Locking bolts	88-102 Nm	65-75 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Oil pan fasteners	9.7 Nm	86 **in-lbs**	6.4 TRANSMISSION, Assembly
Oil pickup fasteners	9.7 Nm	86 **in-lbs**	6.4 TRANSMISSION, Assembly
Rear axle nut	190-203 Nm	140-150 ft-lbs	6.9 DRIVE BELT, Replacement
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	6.3 CLUTCH, Installation
Secondary clutch actuator crankcase cover fasteners	10 Nm	88 **in-lbs**	6.3 CLUTCH, Installation
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**	6.9 DRIVE BELT, Replacement
Spring screws	9.7 Nm	86 **in-lbs**	6.3 CLUTCH, Assembly

DIGITAL TECHNICIAN II PARTSTRADER

SPECIFICATIONS: TRANSMISSION 6.2

GENERAL

Table 6-1. Primary Gearing

ENGINE OUTPUT	TRANSMISSION INPUT	RATIO
64	117	1.828

Table 6-2. Transmission Gearing

GEAR	INPUT	OUTPUT	RATIO
1st	18	45	2.500
2nd	25	42	1.680
3rd	29	39	1.345
4th	31	36	1.161
5th	25	26	1.040

Table 6-3. Secondary Gearing

TRANSMISSION OUTPUT	REAR WHEEL	RATIO
30 (HDI)	72	2.4
28 (DOM)	72	2.571

Table 6-4. Overall Gear Ratios

GEAR	DOMESTIC	INTERNATIONAL
1st gear	11.752	10.969
2nd gear	7.898	7.371
3rd gear	6.322	5.900
4th gear	5.459	5.095
5th gear	4.899	4.563

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CLUTCH 6.3

REMOVAL

PART NUMBER	TOOL NAME
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-48625	CLUTCH HUB HOLDER

1. See Figure 6-1. If engine is in chassis, remove secondary clutch actuator cover.
2. Remove three fasteners on secondary clutch actuator and remove from clutch housing. Wrap clutch actuation cylinder with shop towel and secure away from engine.
3. Remove exhaust system. See 4.15 EXHAUST SYSTEM: VRSCF or 4.15 EXHAUST SYSTEM: VRSCF.
4. See Figure 6-2. Loosen and remove clutch side crankcase cover fasteners in reverse order of torque sequence.
5. Remove clutch side crankcase cover.

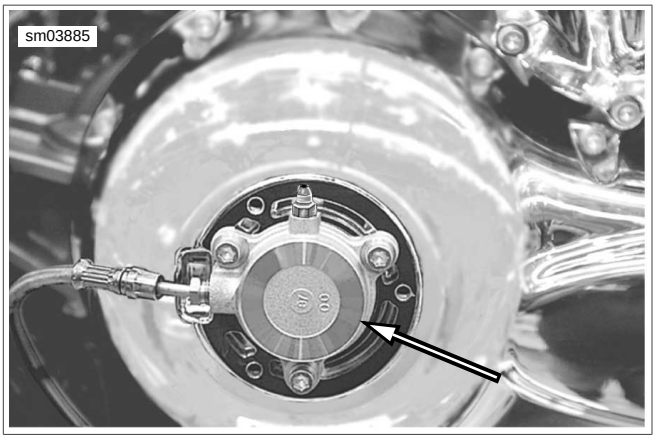


Figure 6-1. Secondary Clutch Actuator

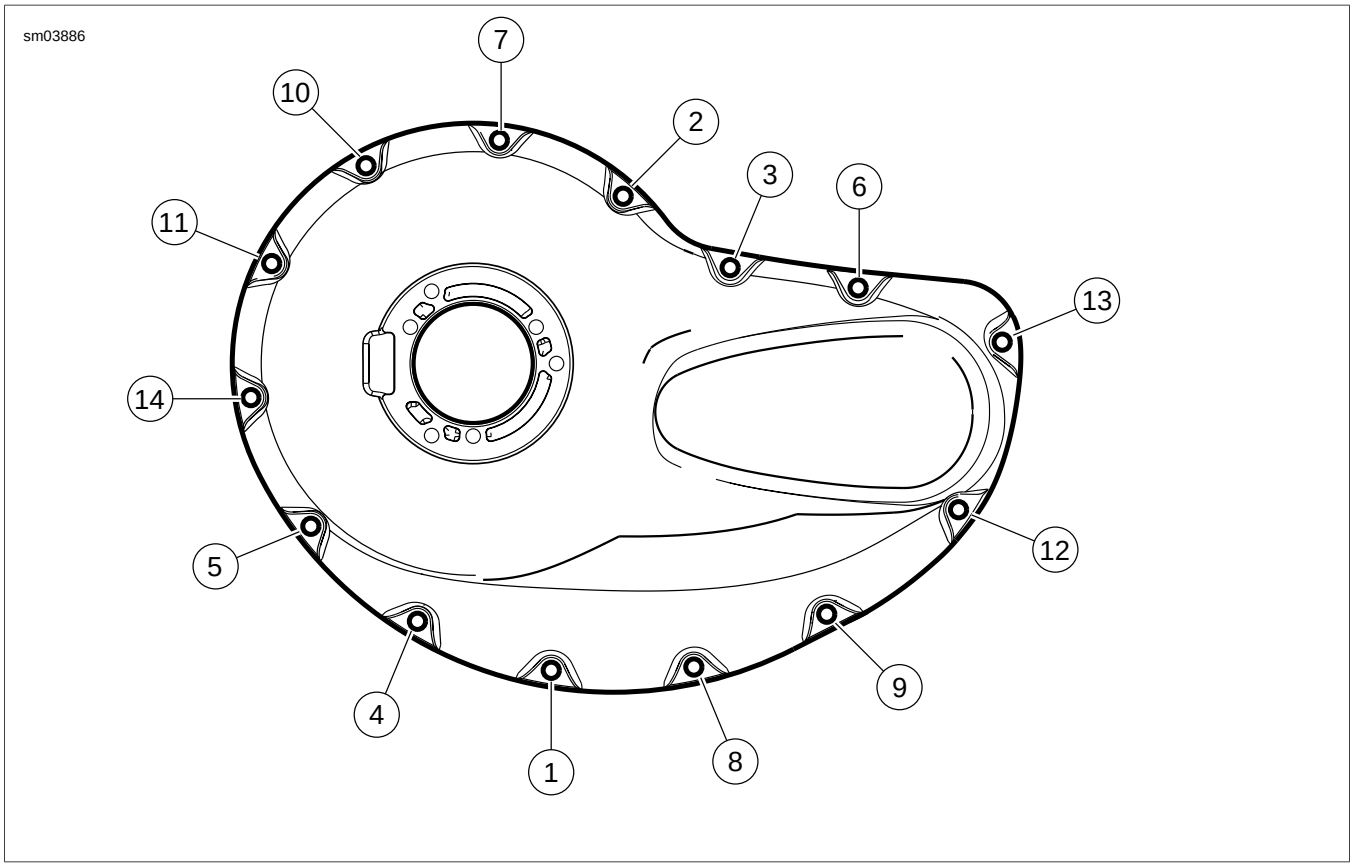
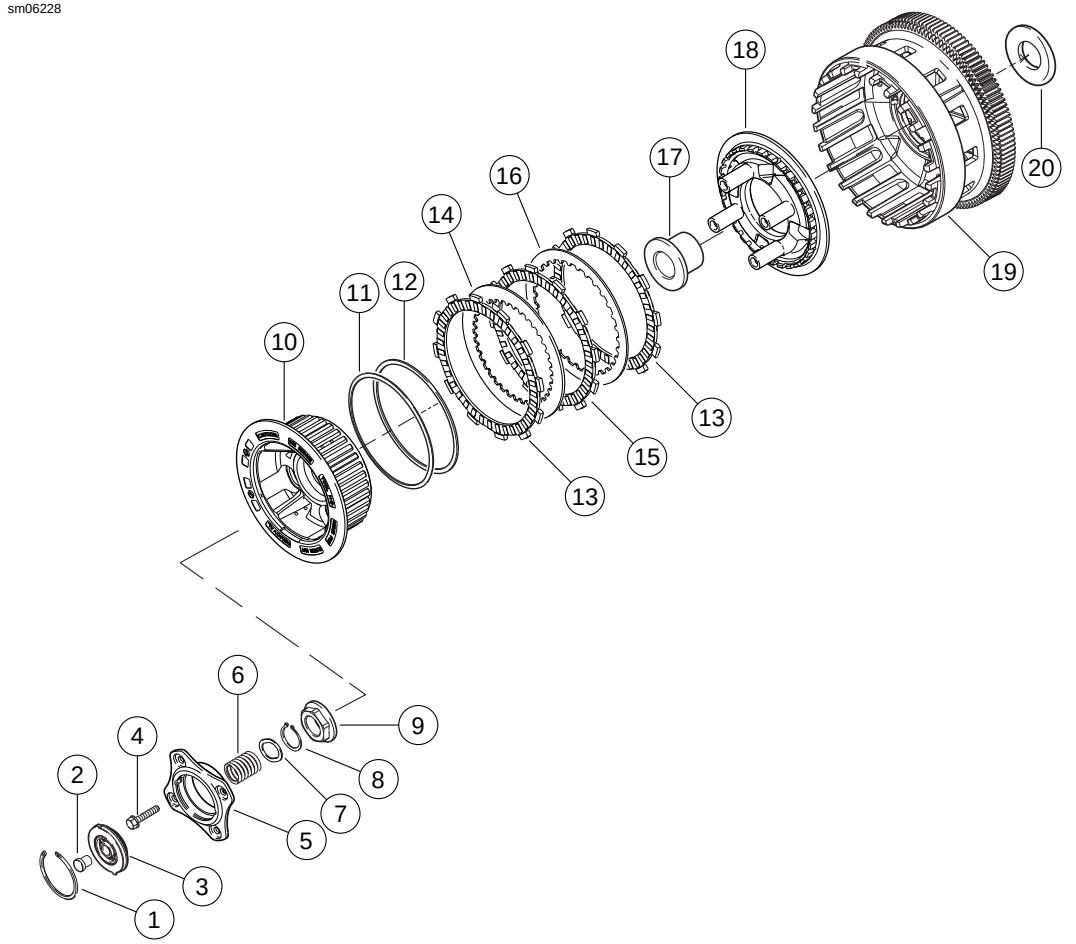


Figure 6-2. Clutch Side Crankcase Cover Torque Sequence



1. Retaining ring
2. Contact button
3. Lifter guide
4. Bolt (4)
5. Lifter plate
6. Pressure plate spring (4)
7. Pressure plate spring seat (4)
8. Clutch hub nut retaining ring
9. Clutch hub nut
10. Clutch hub
11. Damper spring seat
12. Damper spring
13. Friction plate (with close-spaced friction material) (2)
14. Separator plate (small I.D) (7)
15. Frication plate (with wide spaced friction material) (7)
16. Separator plate (large I.D.)
17. Distance collar
18. Pressure plate
19. Clutch basket
20. Thrust washer

Figure 6-3. Clutch

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

6. See Figure 6-4. Remove retaining ring and lifter guide.

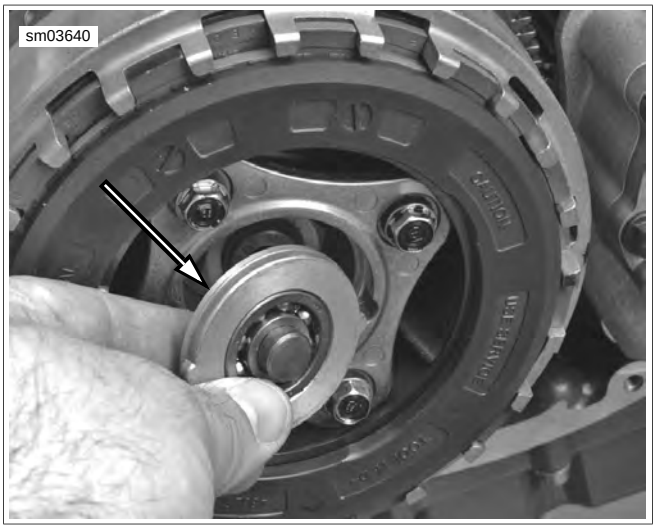


Figure 6-4. Lifter Guide

7. See Figure 6-5. Remove clutch hub nut retaining ring.
8. See Figure 6-6. Install CLUTCH HUB HOLDER (Part No. HD-48625). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

NOTE

Use CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) to rotate crankshaft.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

9. See Figure 6-7. Be sure to properly engage the clutch hub.

NOTE

It may be necessary to rotate crankshaft slightly to properly engage the clutch hub.

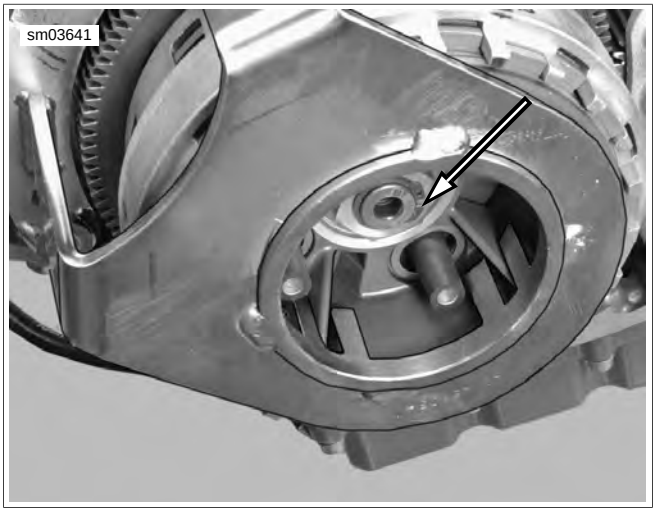


Figure 6-5. Clutch Hub Nut Retaining Ring



Figure 6-6. Clutch Hub Holder Dowel Pin Position

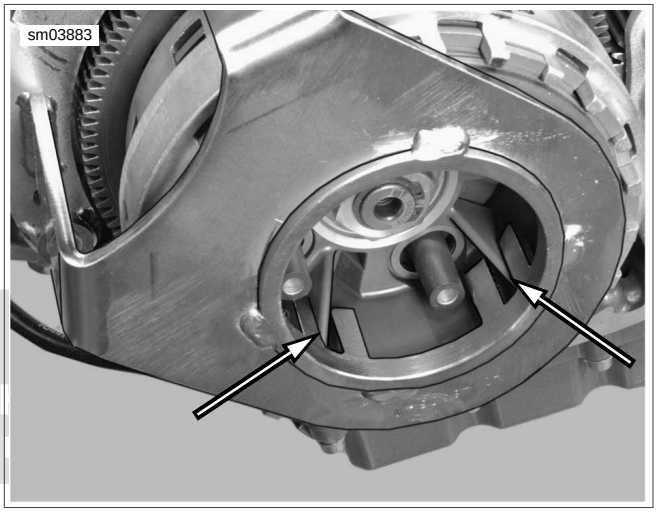


Figure 6-7. Tool and Hub Properly Engaged (shown with lifter plate removed for photo clarity)

⚠WARNING

Be sure to follow manufacturer's instructions when using propane torches. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00465c)

NOTES

- *When threadlocker cannot be loosened using conventional methods, apply moderate heat or use an air impact wrench ONLY TO LOOSEN clutch hub mainshaft nut. Failure to do so may result in damaged clutch hub and/or threads.*
- *When applying heat to the clutch hub mainshaft nut, do so carefully. Excessive heat will damage pressure plate springs.*

10. Heat clutch hub nut with a propane torch to loosen threadlocker. If necessary, an air impact can be used (REMOVAL ONLY) to remove nut.

NOTE

*Clutch hub nut is one-time-use only. Always use a **new** nut for assembly.*

11. See Figure 6-8. Remove clutch hub nut and discard.
12. Remove CLUTCH HUB HOLDER (Part No. HD-48625).
13. See Figure 6-9. Remove clutch assembly.
14. See Figure 6-10. Note position of thrust washer behind the clutch basket.

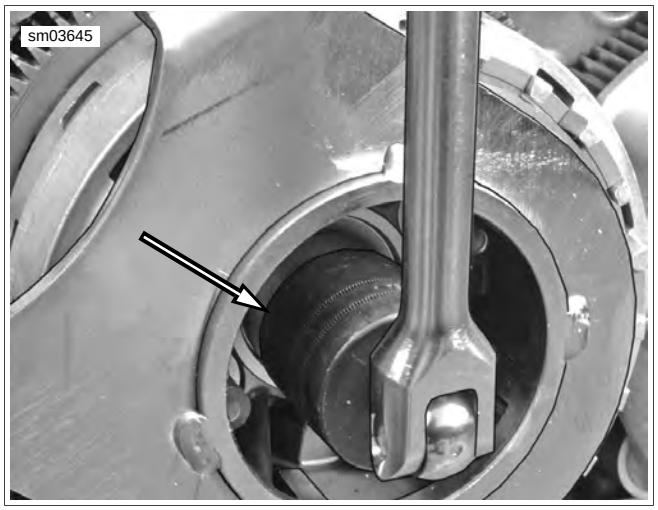


Figure 6-8. Remove Clutch Hub Nut



Figure 6-9. Remove Clutch Assembly (lifter plate removed for photo clarity)

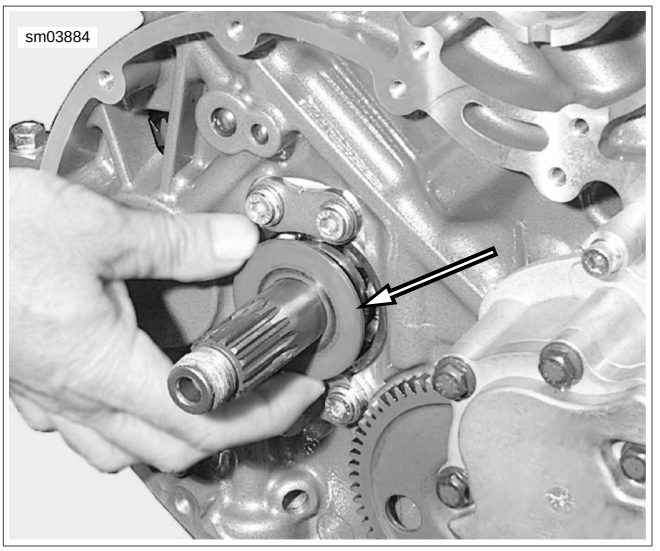


Figure 6-10. Thrust Washer Position

DISASSEMBLY

1. Remove clutch pack from clutch basket.
2. See Figure 6-11. To prevent breaking lifter plate, slowly loosen (2-3 turns at a time) fasteners in a crisscross pattern.
3. See Figure 6-12. Remove clutch springs and measure clutch spring free length.
4. Replace clutch springs if free length is less than 42 mm (1.65 in).
5. Slide hub from the clutch plate. Remove friction plates and steel plates for inspection.

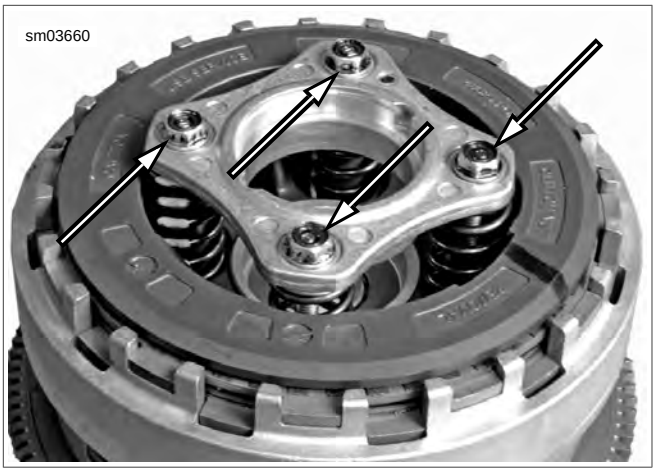


Figure 6-11. Lifter Plate Fasteners

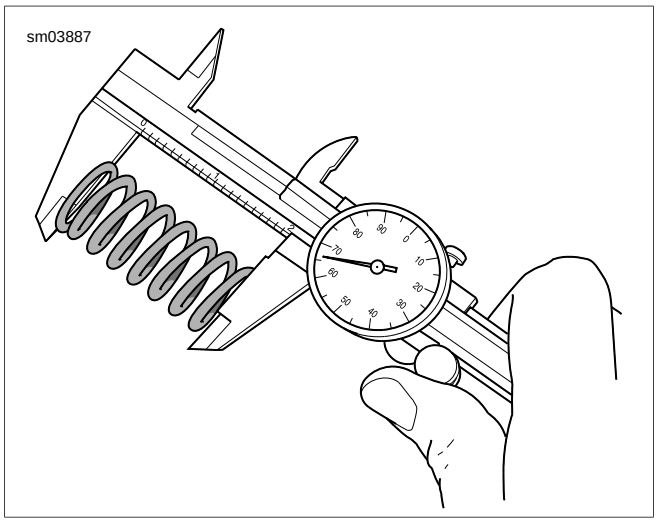


Figure 6-12. Measure Clutch Spring Free Length

CLEANING AND INSPECTION

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Use low pressure compressed air to dry parts.
2. Check friction plates as follows:
 a. Use low pressure compressed air to remove all lubricant from the **friction plates**. Do not wipe off with a rag.
 b. Look for worn or damaged fiber surface material (both sides).
 c. Measure the thickness of each plate with a dial caliper or micrometer.
 d. If the thickness of any plate is less than 3.62 mm (0.142 in.), discard all friction plates and replace with an entirely **new** set.

NOTE

*Replace all nine friction plates with an entirely **new** set if any individual plate shows evidence of wear or damage. Friction plates must be presoaked before installation.*

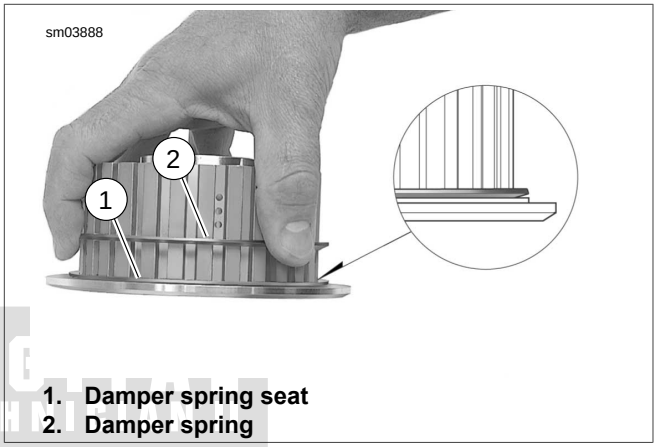
3. Check the **steel plates** as follows:
 a. Discard any plate that is grooved or bluish in color. Blue plates are likely warped or distorted.
 b. Check each plate for distortion. Lay the plate on a precision flat surface. Insert a feeler gauge between the plate and the flat surface in several places. Replace any steel plate that is warped more than 0.15 mm (0.006 in.).
4. Holding the clutch hub, rotate the pressure plate to check bearing for smoothness. Replace the bearing if it runs rough, binds or has any end play.
5. Check ramps for excessive wear. Replace hub if ramps are worn or damaged.

ASSEMBLY

PART NUMBER	TOOL NAME
HD-45654	CLUTCH DISC ALIGNING SPACER

FASTENER	TORQUE VALUE	
Spring screws	9.7 Nm	86 **in-lbs**

1. See Figure 6-13. Slide steel damper spring with concave side up into position on spring seat on clutch outer hub.



1. **Damper spring seat**
2. **Damper spring**

Figure 6-13. Damper Spring Position

NOTES

- ***New** plates should be soaked for 10 minutes in GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 and assembled wet.*
- *Note different spacings in friction material on friction plates, as well as one larger inner-diameter steel plate. The closely spaced friction material plates go ONLY on the outboard positions during assembly.*

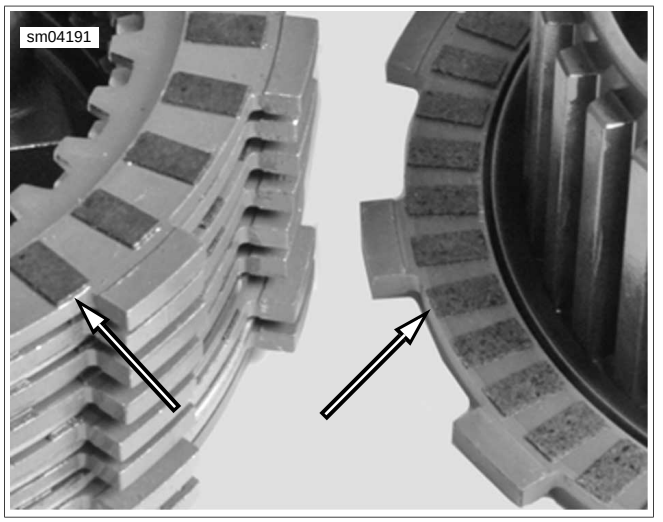


Figure 6-14. Friction Plate Material Spacing Difference (outboard plate shown on right)

2. See Figure 6-14. Install one closely-spaced friction material plate onto clutch hub, and one onto pressure plate.

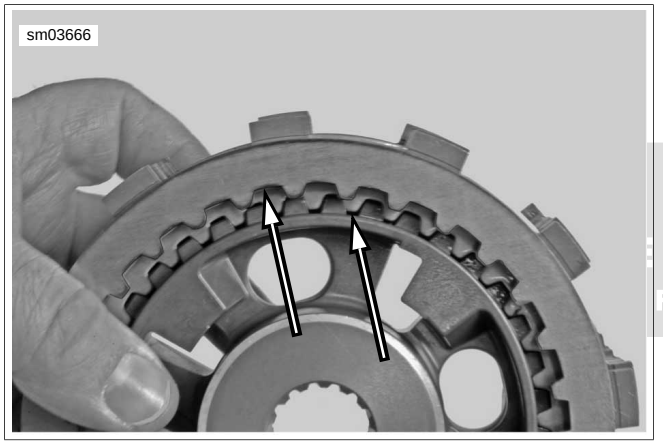


Figure 6-15. Difference in Steel Plate Diameters

3. See Figure 6-15. Note inside diameter difference on single steel plate.



Figure 6-16. Proper Stacking of Spacer and Friction Plates

4. See Figure 6-16. Install large inside diameter steel plate on top friction plate previously installed on pressure plate, then a regular-spaced friction plate as shown.
5. Stack remaining plates on clutch hub, alternating friction plate, steel plate until all plates are in place.



Figure 6-17. Assemble Clutch Hub and Pressure Plate

6. See Figure 6-17. Place assembled clutch hub on bench, and assembled pressure plate in hand, slowly mate clutch halves until fully seated and align plate tabs so clutch pack assembly can drop into clutch basket under its own weight.



Figure 6-18. Clutch Pack Assembled Correctly

7. See Figure 6-18. Verify clutch pack is fully seated as shown with no space visible between plates and carefully flip clutch pack over onto the opposite side.

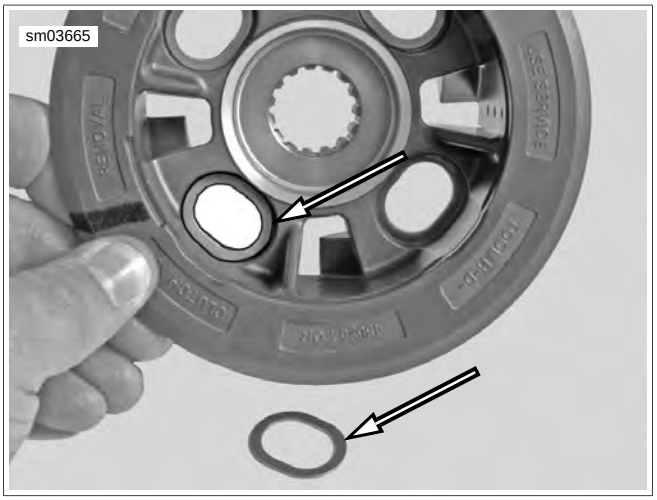


Figure 6-19. Spring Seat Washer and Location on Clutch Hub

8. See Figure 6-19. Place a small amount of oil on each spring seat washer and install four pressure plate spring seat washers.



Figure 6-20. Assemble Clutch Pack

9. See Figure 6-20. Install four pressure plate springs over the threaded bosses on the pressure plate. Position the lifter plate over the springs and loosely install fasteners to allow clutch plates to be moved for final alignment.

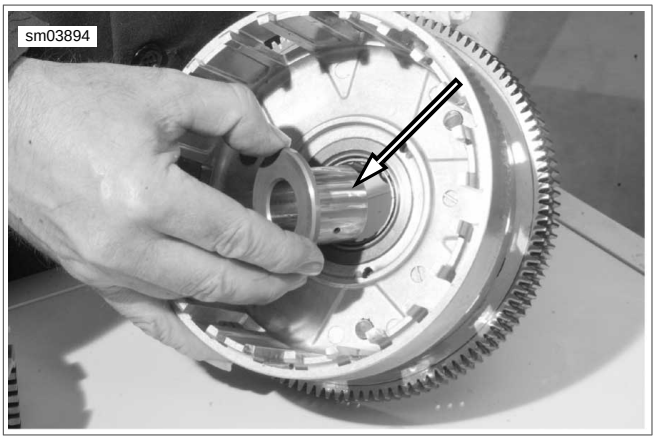


Figure 6-21. Distance Collar

10. See Figure 6-21. Install distance collar in clutch basket as shown.

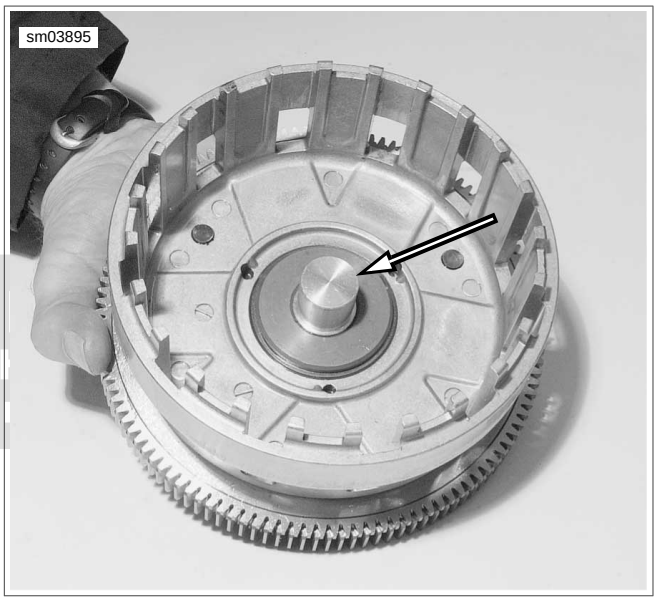


Figure 6-22. Clutch Disc Aligning Spacer (HD-45654)

11. See Figure 6-22. Insert CLUTCH DISC ALIGNING SPACER (Part No. HD-45654) from the primary gear side.



Figure 6-23. Insert Clutch Pack and Align Top Plate as Shown

12. See Figure 6-23. Insert clutch pack and align top friction plate. Top friction plate must be indexed to fit in the top slot of the clutch basket.



Figure 6-24. Spring Screws

13. See Figure 6-24. Using a cross pattern, tighten four spring screws to 9.7 Nm (86 **in-lbs**).

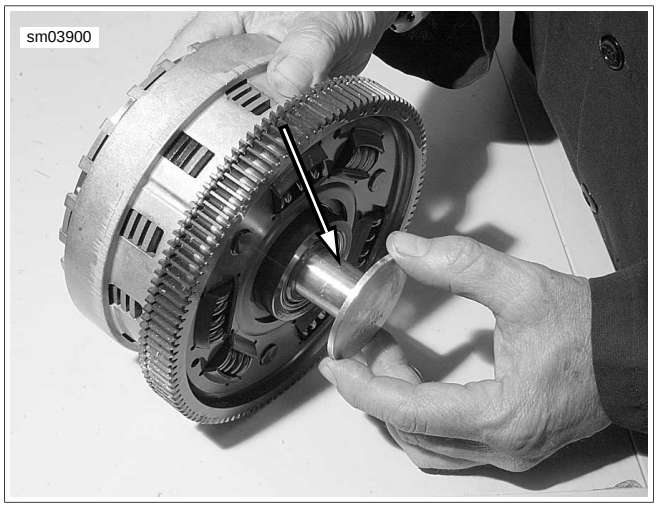


Figure 6-25. Remove Clutch Disc Aligning Spacer Tool (HD-45654)

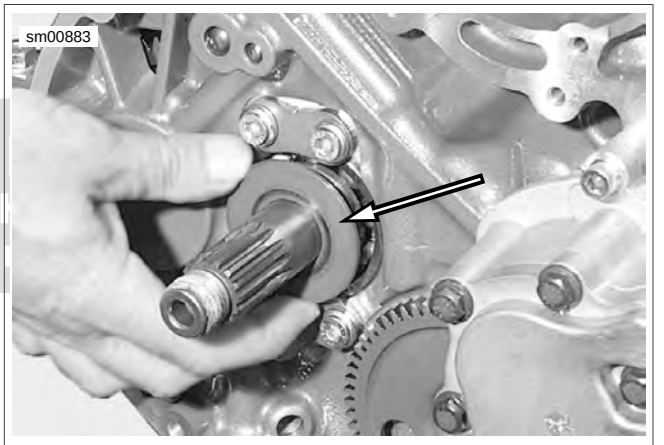
14. See Figure 6-25. Remove CLUTCH DISC ALIGNING SPACER (Part No. HD-45654).

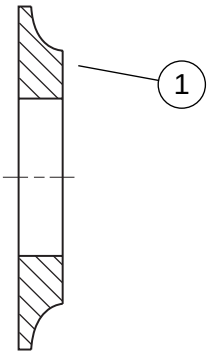
INSTALLATION

PART NUMBER	TOOL NAME
HD-45340	GASKET ALIGNMENT DOWELS
HD-48625	CLUTCH HUB HOLDER

FASTENER	TORQUE VALUE	
Clutch hub nut	220 Nm	162 ft-lbs
Clutch side crankcase cover fasteners	9.7 Nm	86 **in-lbs**
Secondary clutch actuator crankcase cover fasteners	10 Nm	88 **in-lbs**
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**

1. Remove clutch pack from clutch basket.
2. See Figure 6-26. Install thrust washer.
3. See Figure 6-27. Slide clutch basket on to the input shaft.





1. **This side toward engine case**

Figure 6-26. Thrust Washer Position



Figure 6-27. Clutch Basket

4. See Figure 6-28. Clutch basket will not go completely into position until the spring loaded backlash gear is aligned. Use a suitable drift pin in hole to align backlash gear.
5. See Figure 6-29. Slide clutch pack into clutch housing. It may be necessary to rotate input shaft to align splines of shaft and outer hub.
6. See Figure 6-6. Install CLUTCH HUB HOLDER (Part No. HD-48625). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

7. See Figure 6-7. If necessary, rotate engine slightly to properly engage the clutch hub.

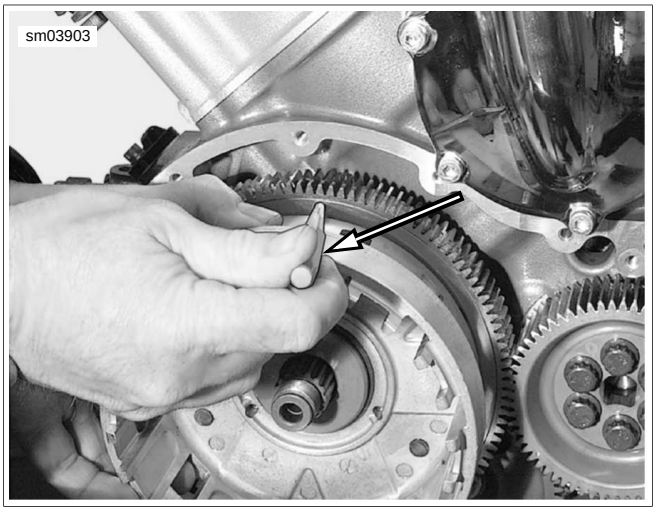


Figure 6-28. Back Lash Gear Adjustment

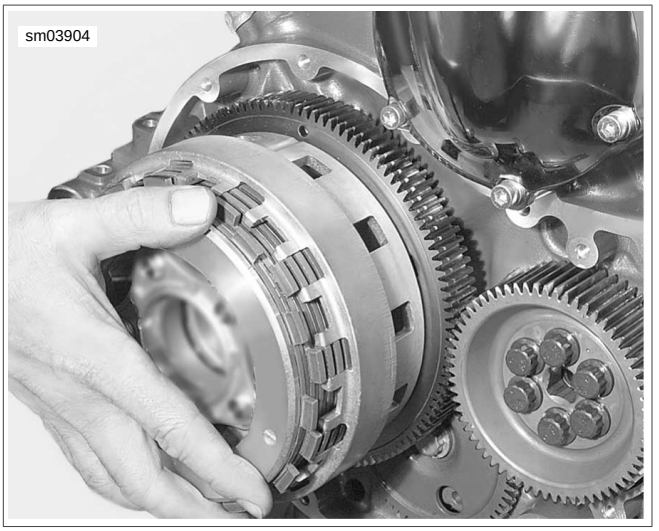


Figure 6-29. Install Clutch Pack (typical)

NOTE

*Clutch hub nut is one-time-use only. Always use a **new** nut for assembly.*

8. Install CLUTCH HUB HOLDER (Part No. HD-48625).
9. Install a **new** clutch hub nut and tighten to 220 Nm (162 ft-lbs).

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

10. Install **new** clutch hub nut retaining ring.
11. Remove CLUTCH HUB HOLDER (Part No. HD-48625).
12. Install oil retaining ring.
13. Install lifter guide and retaining ring.

NOTE

Install GASKET ALIGNMENT DOWELS (Part No. HD-45340) to aid in cover installation.

14. See Figure 6-30. Install clutch side crankcase cover. Tighten fasteners in sequence to 9.7 Nm (86 **in-lbs**).
15. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).
16. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).
17. Install exhaust system. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF.

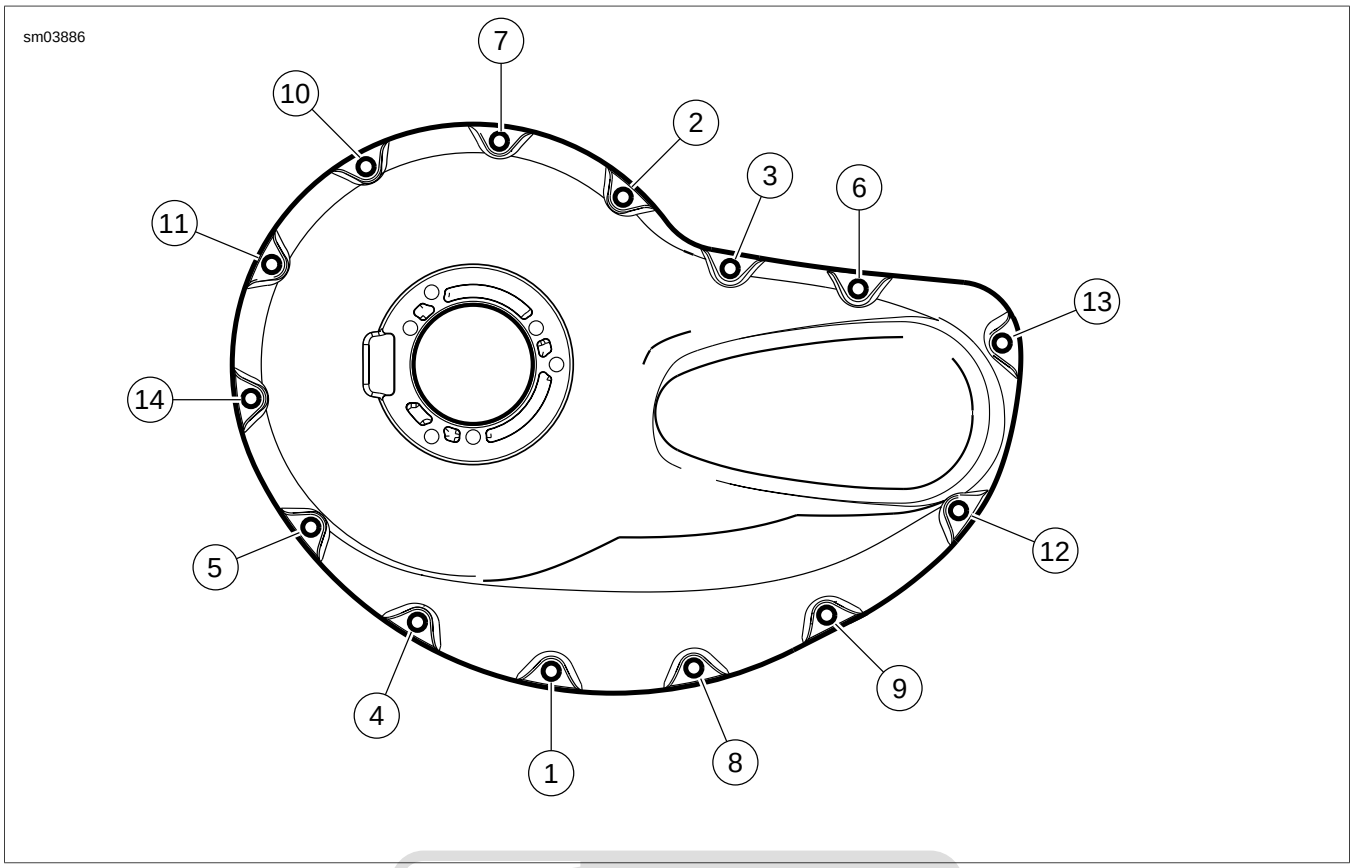


Figure 6-30. Clutch Side Crankcase Cover Torque Sequence

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-45339	SHIFT MECHANISM/DENTENT RETRACTOR

NOTICE

Whenever case halves are separated for service, crankshaft bearings must be replaced. Failure to replace bearings will result in engine damage. (00551b)

1. See Figure 6-31. Remove input shaft.
2. See Figure 6-33. Note the alignment pins on the bearing outer race. Replace bearings having damaged or missing pins.

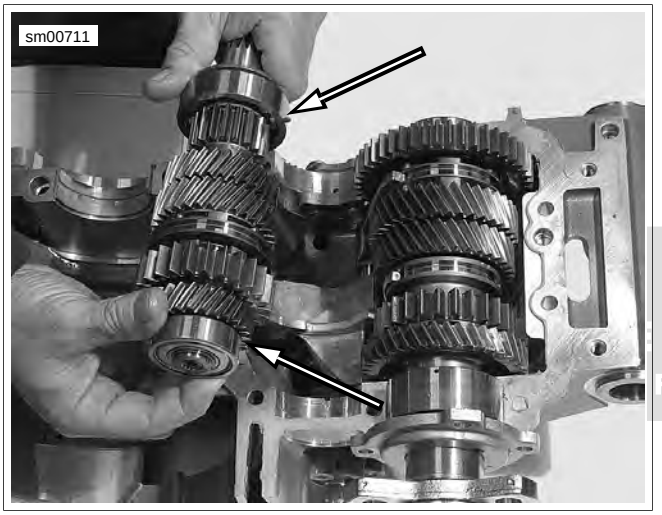


Figure 6-31. Input Shaft

3. Remove two fasteners on drive sprocket flange seal retainer.
4. See Figure 6-32. Remove output shaft.
5. See Figure 6-31. Note the alignment pins on the bearing outer race. Replace bearings having damaged or missing pins. See 6.7 OUTPUT SHAFT.

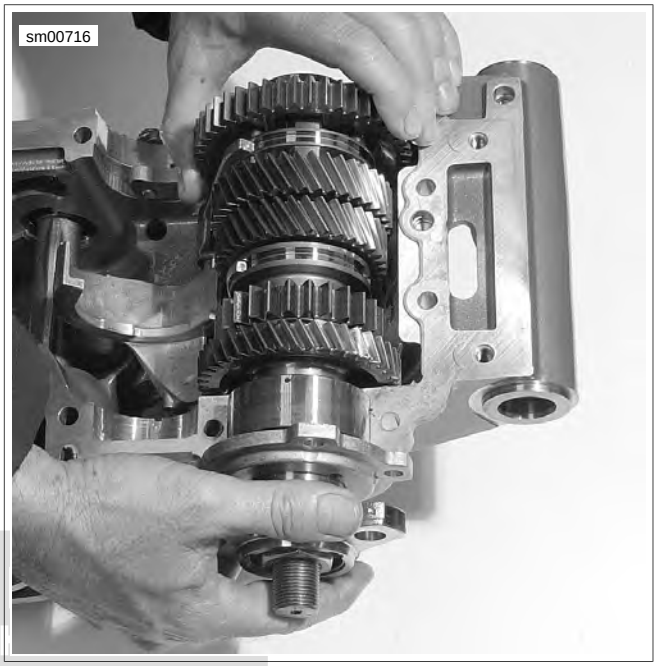
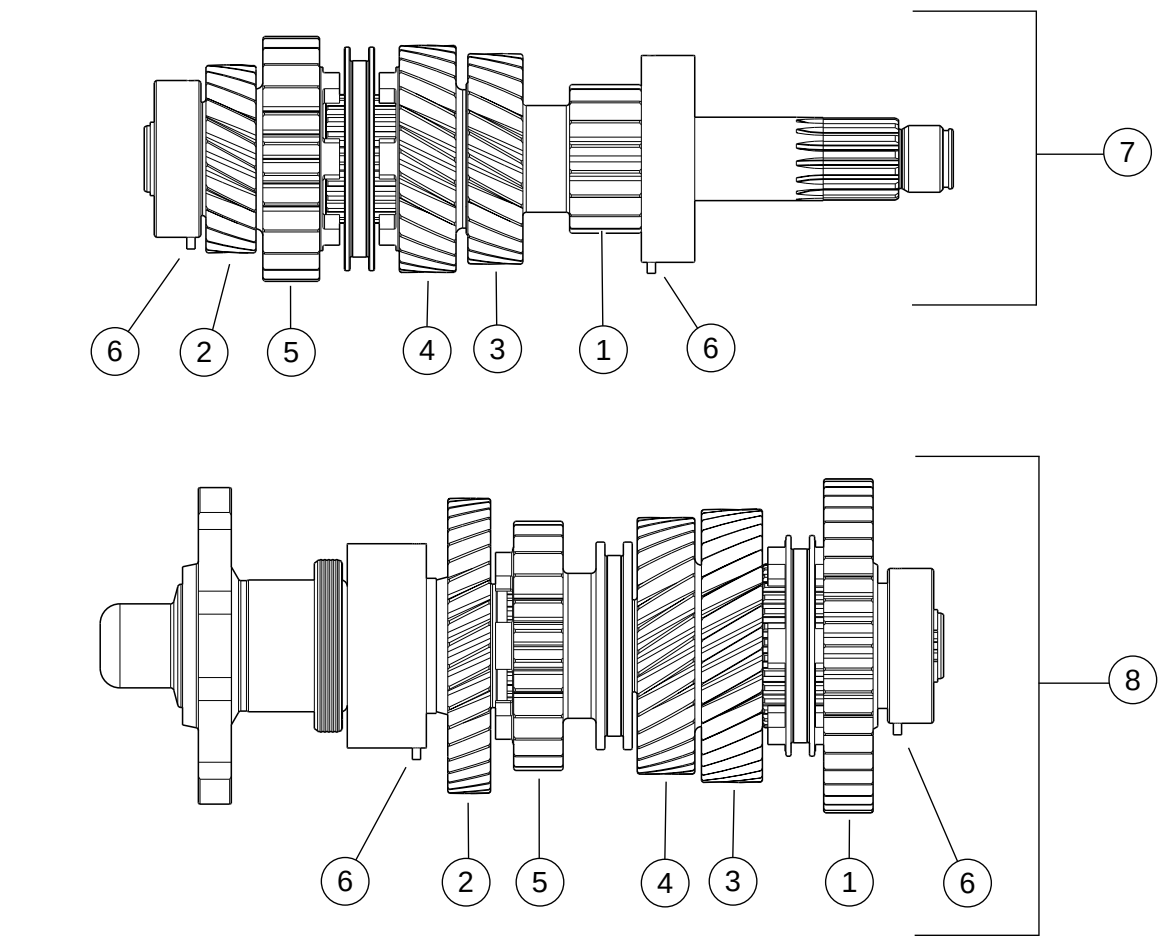


Figure 6-32. Output Shaft



1. **1st gear**
2. **2nd gear**
3. **3rd gear**
4. **4th gear**
5. **5th gear**
6. **Bearing alignment pins (Install with offset toward gears)**
7. **Input shaft**
8. **Output shaft**

Figure 6-33. Transmission Input Shaft and Output Shaft Assemblies

Shift Drum Removal

1. See Figure 6-34. Remove input shaft bearing retainer to fully expose shifting fork shaft.
2. See Figure 6-35. Remove neutral switch.
3. See Figure 6-36. Using a drift pin, pull shifter fork shaft to edge of case to free shifter forks.

NOTE

Shafts in the transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts.

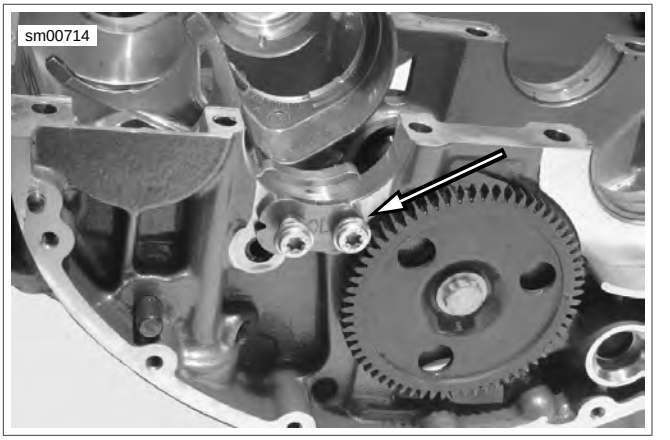


Figure 6-34. Input Shaft Bearing Retainer

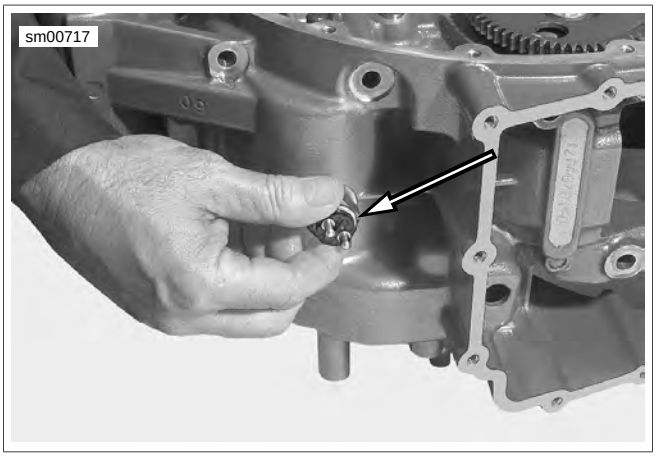


Figure 6-35. Neutral Switch

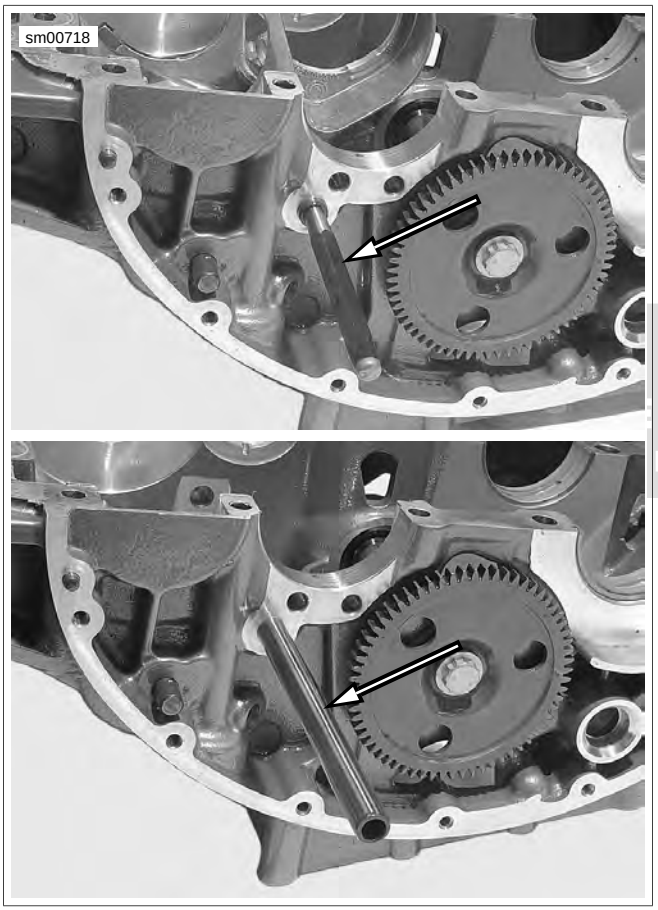


Figure 6-36. Shifter Fork Shaft

4. See Figure 6-37. Use the shifter fork shaft to position the SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339).
 a. Engage the shifter gliding part, tighten brass thumb screw to keep gliding part in retracted position.
 b. Push shifter detent arm spring away from shifting drum star wheel. Lock in place with black knurled thumb screw.
 c. Extract shift drum shaft and remove shift drum.

NOTES

- *Always compress shifter pawl gliding part before shift drum detent arm moved out of position. Failure to do so could bend or break shift detent arm assembly tab.*
- *If the SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339) is positioned correctly the shift drum will rotate freely.*
- *For shift shaft, or shift shaft seal removal, see 6.6 SHIFT SHAFT AND SEAL.*

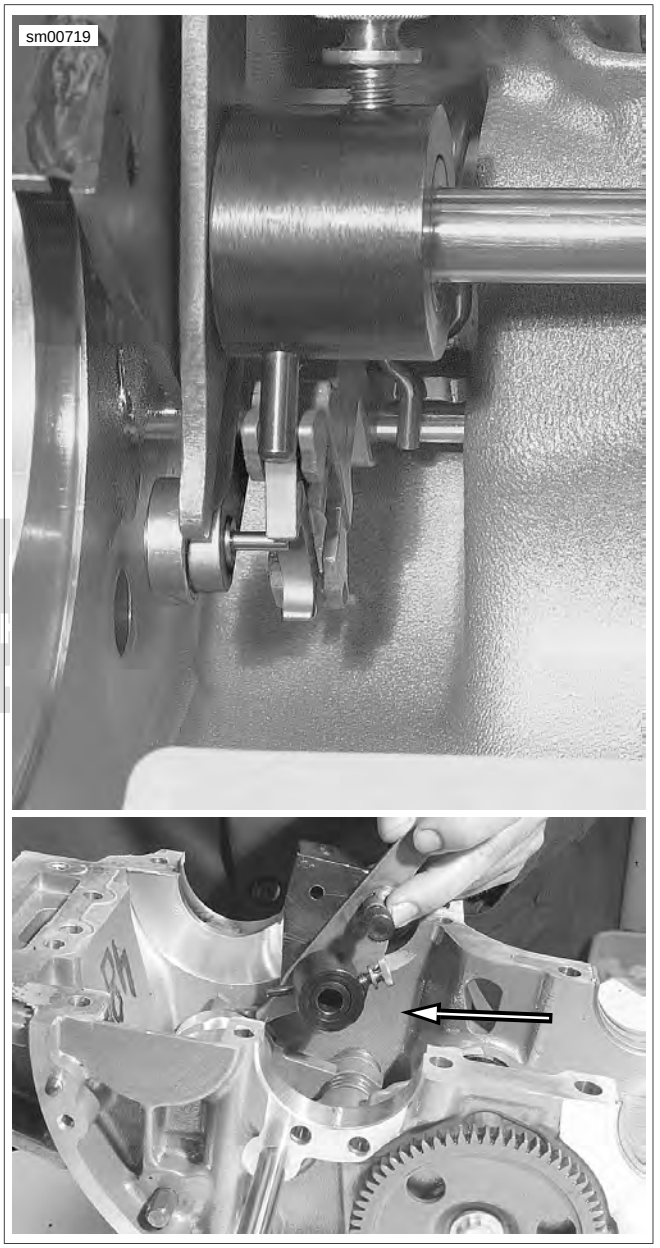


Figure 6-37. Shift Mechanism/Detent Retractor (HD-45339)

ASSEMBLY

PART NUMBER	TOOL NAME
HD-45301	TRANSMISSION ASSEMBLY RETAINER TOOL
HD-45310	LOWER CRANKCASE ALIGNMENT DOWELS
HD-45311	COUNTERBALANCER ALIGNMENT PIN
HD-45316	CRANKSHAFT ASSEMBLY RETAINER
HD-45338	SHIFT LEVER SUBSTITUTE
HD-45339	SHIFT MECHANISM/DENTENT RETRACTOR
SNAP-ON TA360	TORQUE ANGLE GAUGE

FASTENER	TORQUE VALUE	
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs
* Main bearing bolts; first torque then loosen one turn	25 Nm	18.4 ft-lbs
Crankcase/transmission case fasteners	25 Nm	18.4 ft-lbs
* Main bearing bolts; second torque plus 90 degrees	15 Nm	131 **in-lbs**
Input bearing retainer fasteners	23 Nm	17 ft-lbs
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs
Oil pickup fasteners	9.7 Nm	86 **in-lbs**
Oil pan fasteners	9.7 Nm	86 **in-lbs**

NOTE

Shafts in the transmission have close tolerance. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.

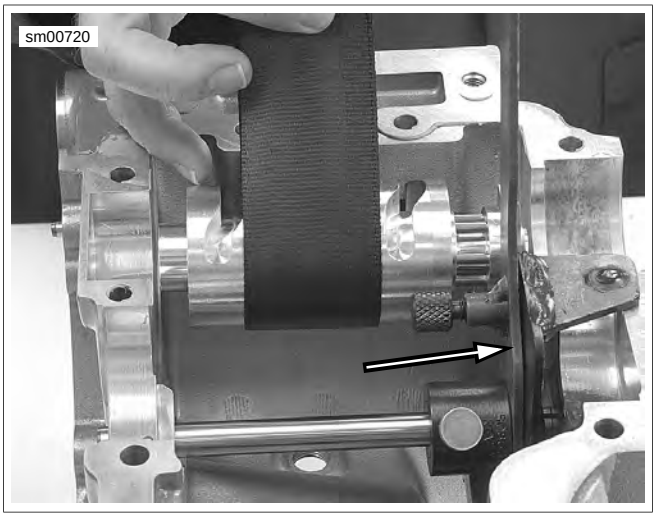


Figure 6-38. Position Shift Drum

1. See Figure 6-38. Use SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339) in reverse of disassembly to compress shifter gliding part and to compress shifting detent arm and spring. Using the nylon strap from the SHIFT MECHANISM/DETENT RETRACTOR (Part No. HD-45339), lower the shift drum in place and insert the shift drum shaft.
2. See Figure 6-39. Insert shifter fork shaft through engine case and slide shifter forks in position.
3. See Figure 6-40. Position shifter forks as shown.
4. See Figure 6-41. Install input shaft bearing retainer loosely in place.

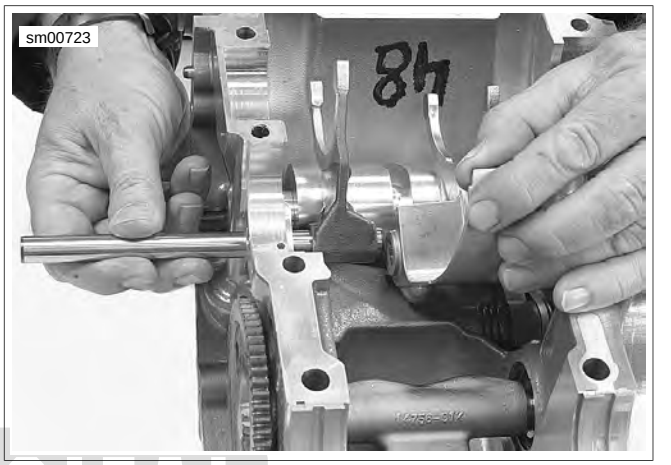


Figure 6-39. Shifter Fork Shaft Installation

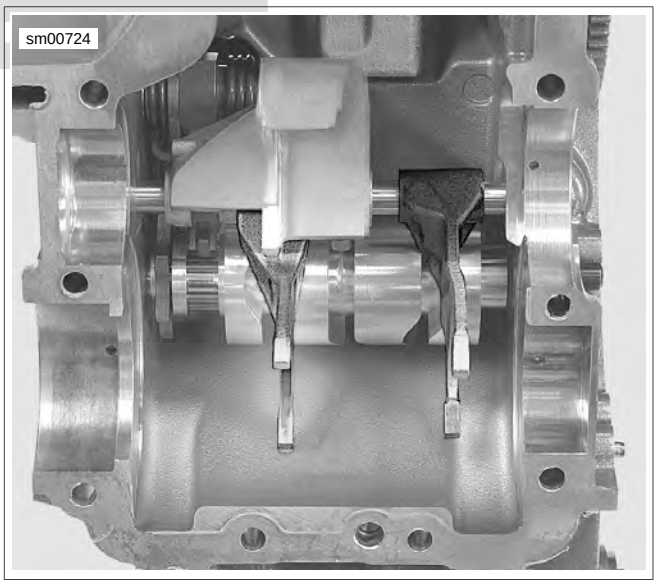


Figure 6-40. Shifter Fork Orientation

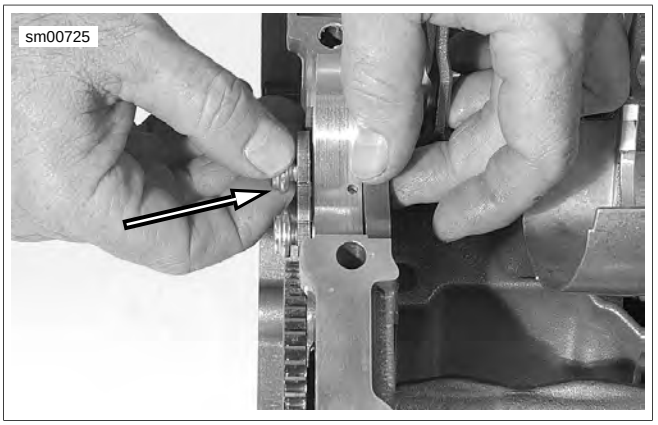


Figure 6-41. Input Shaft Bearing Retainer

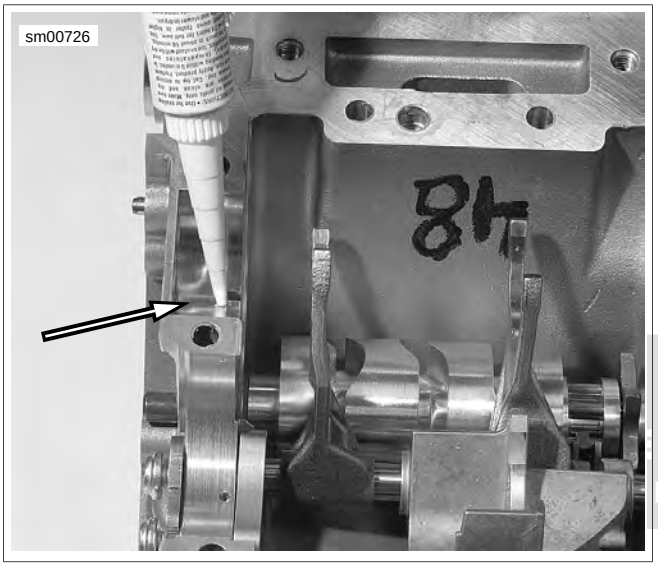


Figure 6-42. Locating Pin Hole

5. See Figure 6-42. Apply a dab of HARLEY-DAVIDSON HIGH-PERFORMANCE SEALANT around the output bearing locating pin hole to keep bearing from dropping during assembly. This is ONLY DONE ON THE OUTPUT SHAFT FIRST GEAR BEARING.

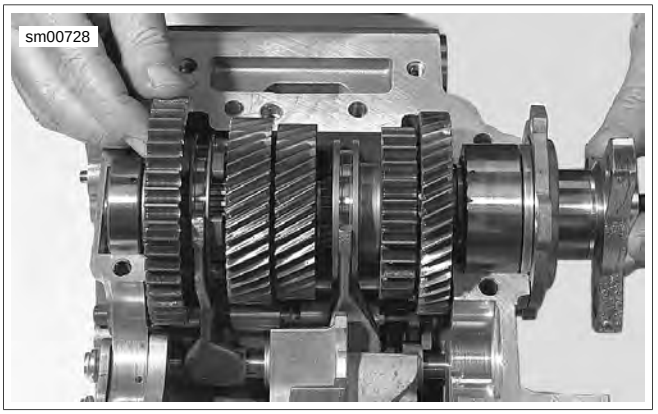


Figure 6-43. Output Shaft

NOTE

Attempting to assemble engine without the bearing alignment pins in the correct position will cause engine damage.

6. See Figure 6-43 and Figure 6-44. Carefully lower output shaft into case. Verify the alignment pins on the bearing outer race are in the case holes.

NOTE

Output shaft will turn freely when it is in the correct position.

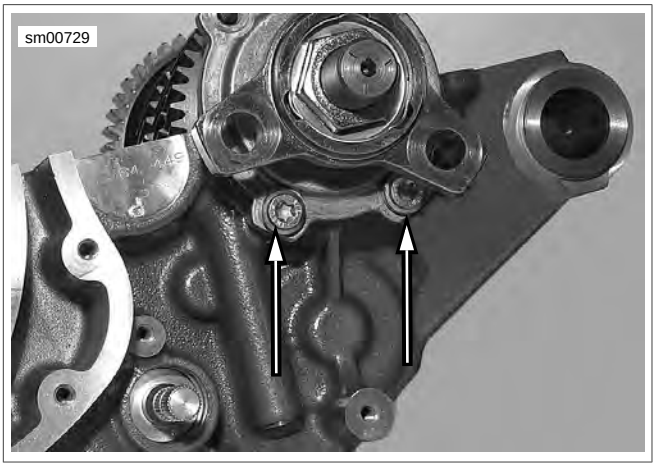


Figure 6-44. Output Shaft Seal Retainer

7. See Figure 6-44. Install two upper case fasteners in drive sprocket seal retainer. Do not tighten at this time.
8. See Figure 6-45 and Figure 6-33. Carefully lower input shaft into case. Inspect to be certain that the alignment pins (6) on the bearing outer race are in the case holes and shifting forks are in the correct location.

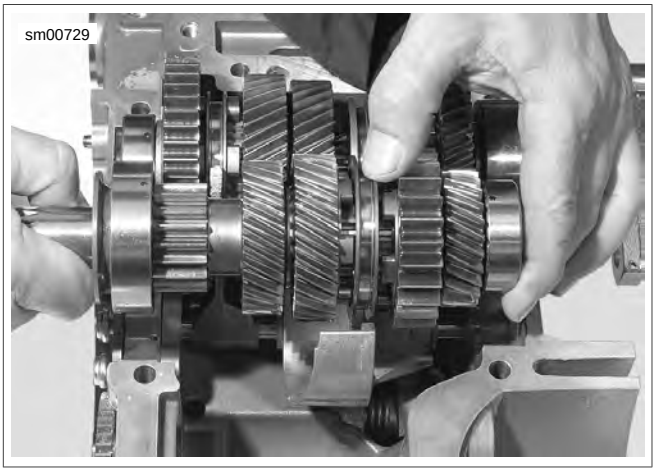


Figure 6-45. Input Shaft

9. See Figure 6-46. Install TRANSMISSION ASSEMBLY RETAINER TOOL (Part No. HD-45301) on input shaft.
10. Use SHIFT LEVER SUBSTITUTE (Part No. HD-45338) to dry shift transmission while rotating input and output shaft. Make sure transmission shifts through all gears correctly.
11. Install neutral switch. See 7.23 NEUTRAL SWITCH.

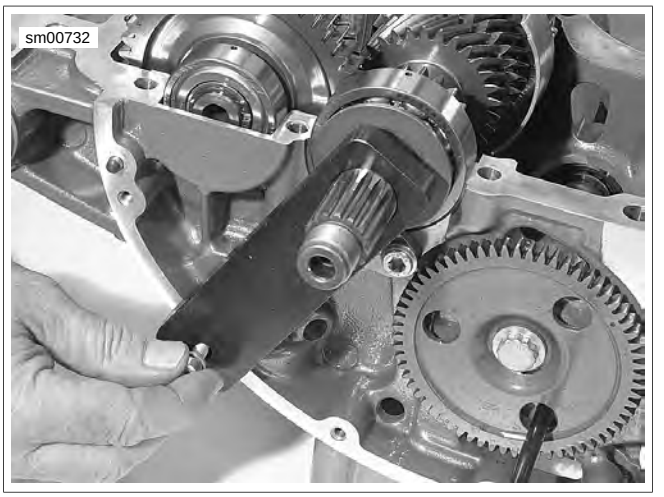


Figure 6-46. Retain Input Shaft

12. See Figure 6-46. Install TRANSMISSION ASSEMBLY RETAINER (Part No. HD-45301) on input shaft as shown.

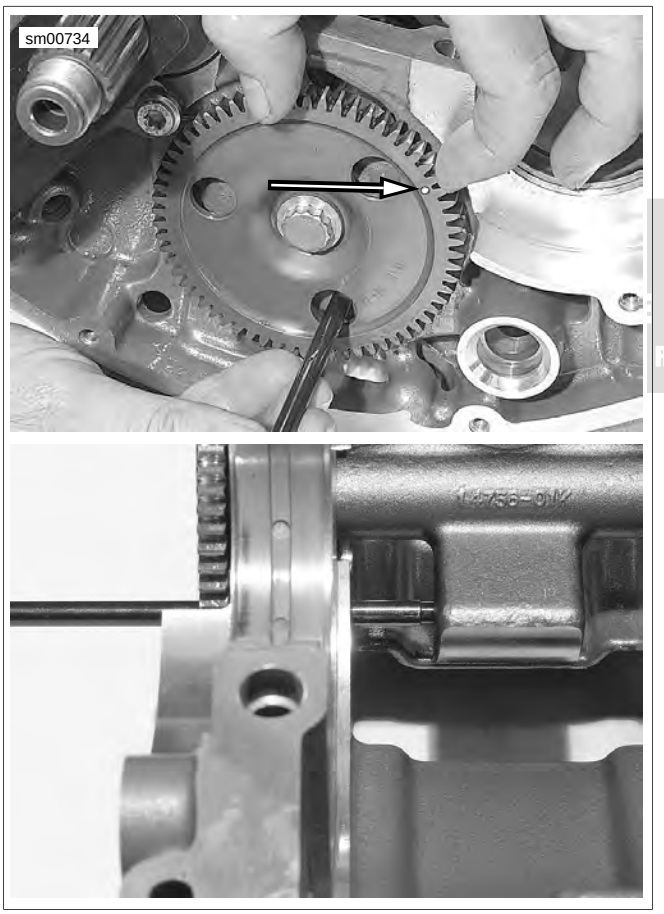


Figure 6-47. Counterbalancer Alignment

13. See Figure 6-47. Install COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311). With the alignment mark in the 2 o'clock position, the case hole and the index hole in the counterbalancer will align.

NOTE

*Install **new** crankshaft bearings every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.*

14. Replace the crankshaft bearings at this time. See 3.12 ENGINE BOTTOM END SERVICE.

15. See Figure 6-48. Lubricate crankshaft bearing surfaces, input and output shaft and counterbalancer bearings with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50. Use SCREAMIN' EAGLE ASSEMBLY LUBE on bearing shells.

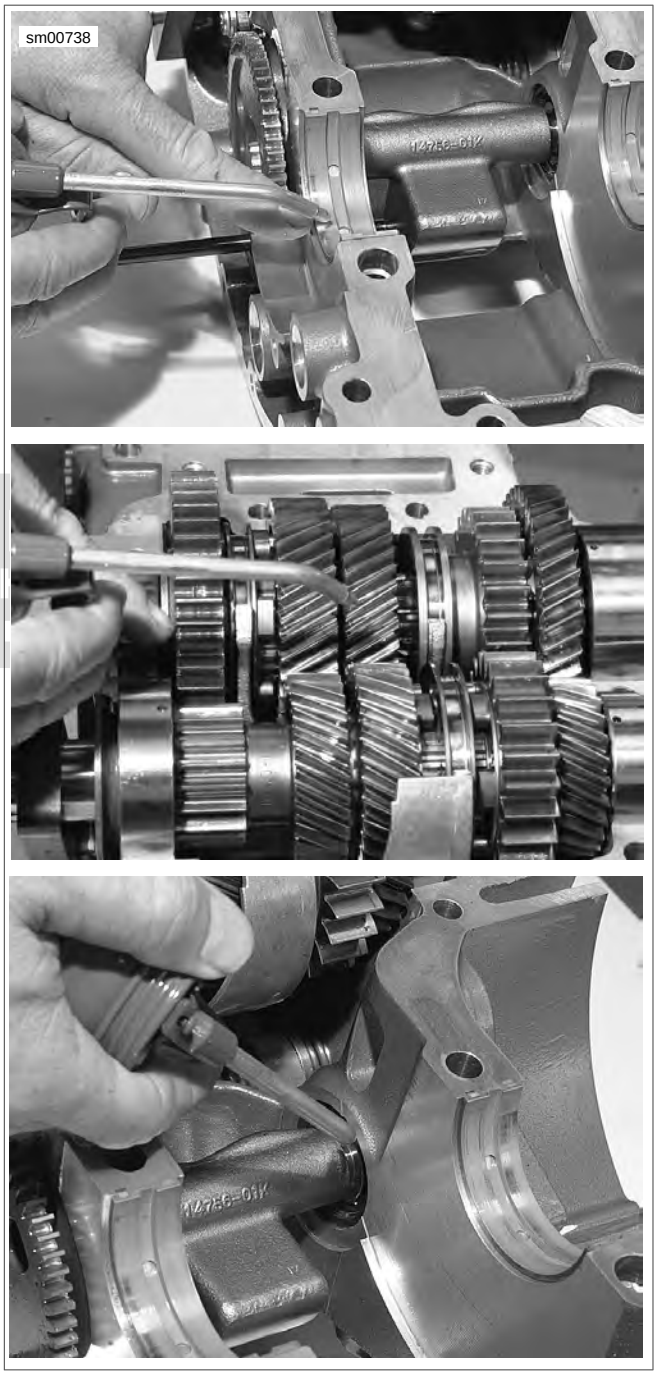


Figure 6-48. Pre-Assembly Lubrication

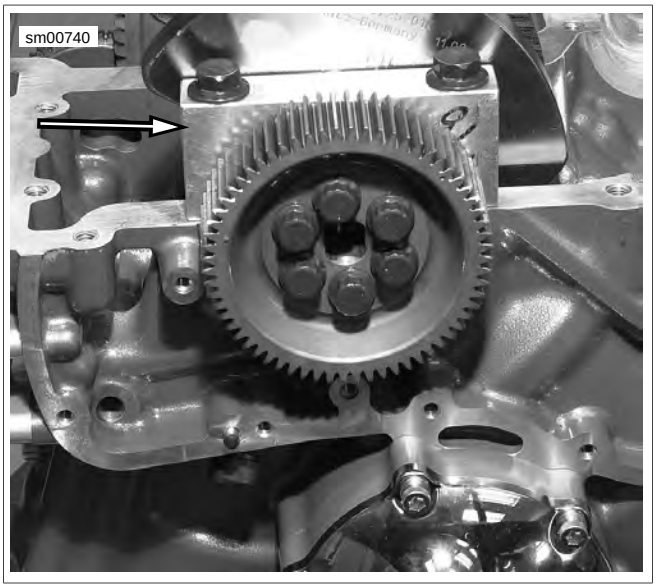


Figure 6-49. Retain Crankshaft Thrust Bearing

16. See Figure 6-49. Position the CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316) to hold crankshaft thrust bearing half in place while attaining TDC.

NOTICE

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

17. Position crankshaft assembly at TDC.

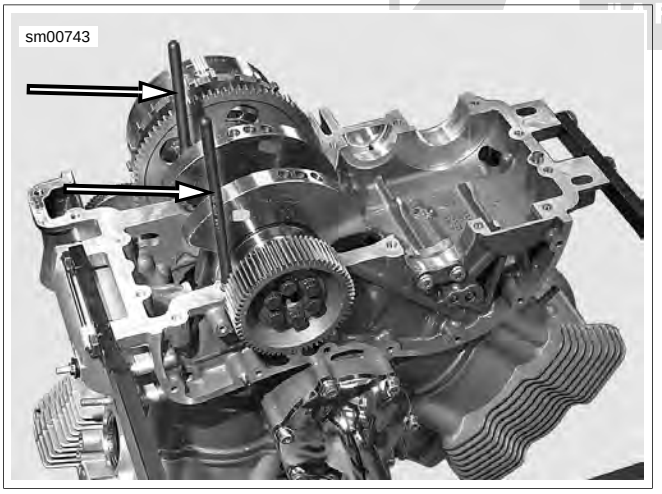


Figure 6-50. Lower Crankcase Alignment Dowels

18. See Figure 6-50. Install LOWER CRANKCASE ALIGNMENT DOWELS (Part No. HD-45310).

NOTE

Remove dipstick if installed.

19. See Figure 6-41. Check that upper crankcase input bearing retainer is loosely in position.

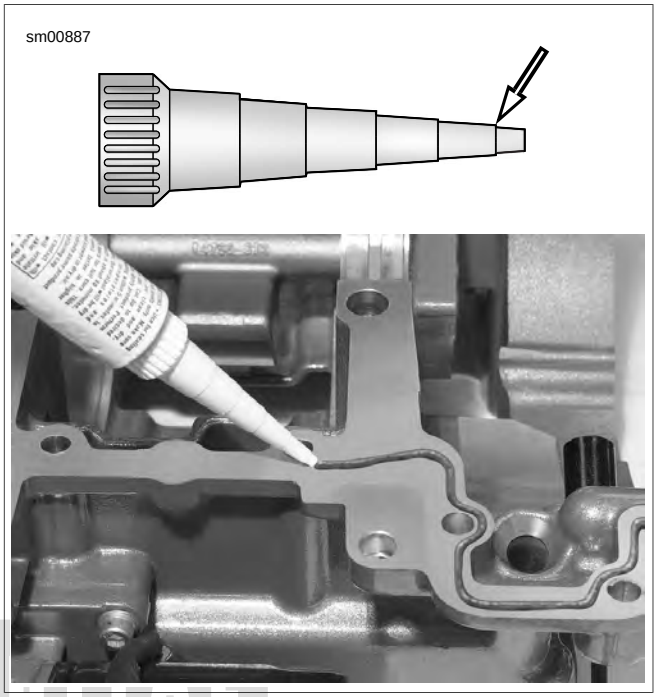


Figure 6-51. Apply Sealant

20. See Figure 6-51. Cut HARLEY-DAVIDSON HIGH-PERFORMANCE SEALANT applicator tip at first step of nozzle.

21. See Figure 6-52. Carefully clean case mating surfaces (gray shaded area).

NOTE

- *Apply sealant only as indicated. Do not seal all mating surfaces.*
- *Excess crankcase sealant squeezed into the crankcases during assembly can clog the oil pick up. Adjust speed and pressure to apply a 1 mm (0.04 in.) bead of sealant.*

Apply 1 mm (0.04 in.) HARLEY-DAVIDSON HIGH PERFORMANCE SEALANT to the lower case half following black line.

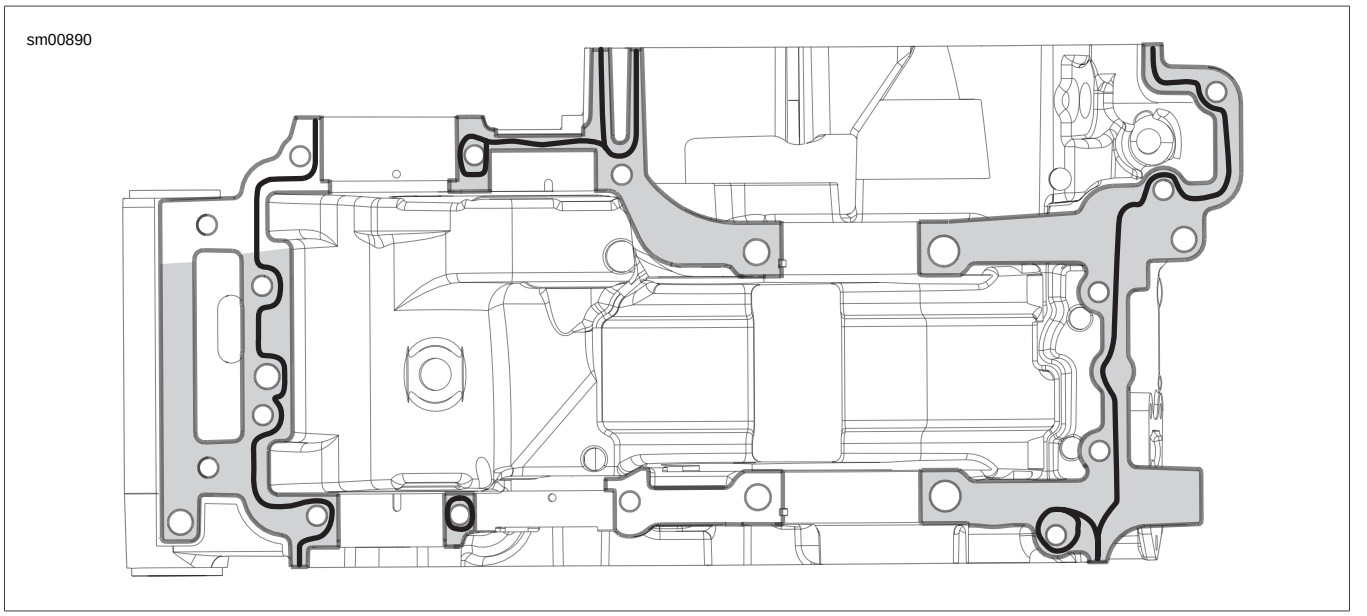


Figure 6-52. Lower Case Sealant Path

NOTES

- *Lower case with the transmission gears in place is heavy. Seek help when lifting lower case.*
- *The cases can be mated with the cases vertical when using rolling engine stand and engine cradle. The starter must face upward.*

22. See Figure 6-53. Position lower case half over the LOWER CRANKCASE ALIGNMENT DOWELS (Part No. HD-45310).
23. See Figure 6-54. When the counterbalancer gear and the primary crankshaft gear are close to engagement, remove the COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).

NOTE

Confirm the correct alignment of the counterbalancer gear and the primary crankshaft gear timing marks. Engine damage will occur if the counterbalancer gear and the primary crankshaft gear are not correctly timed.

24. See Figure 6-55. Hand position the counterbalancer gear so the timing marks are aligned exactly as shown.

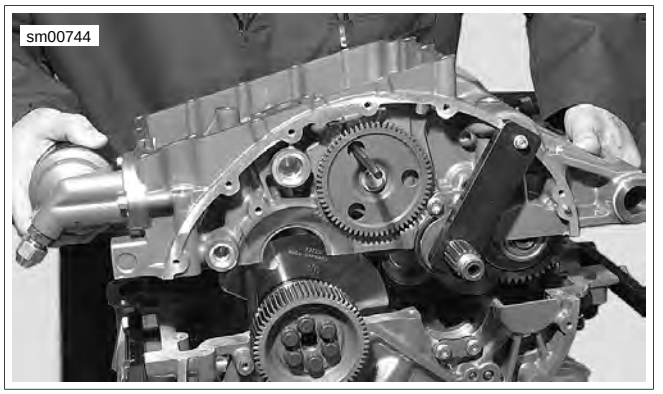


Figure 6-53. Lower Case Over Alignment Dowels

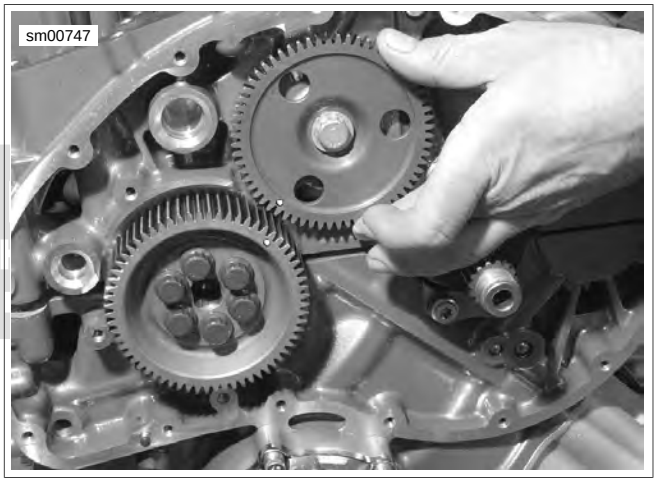
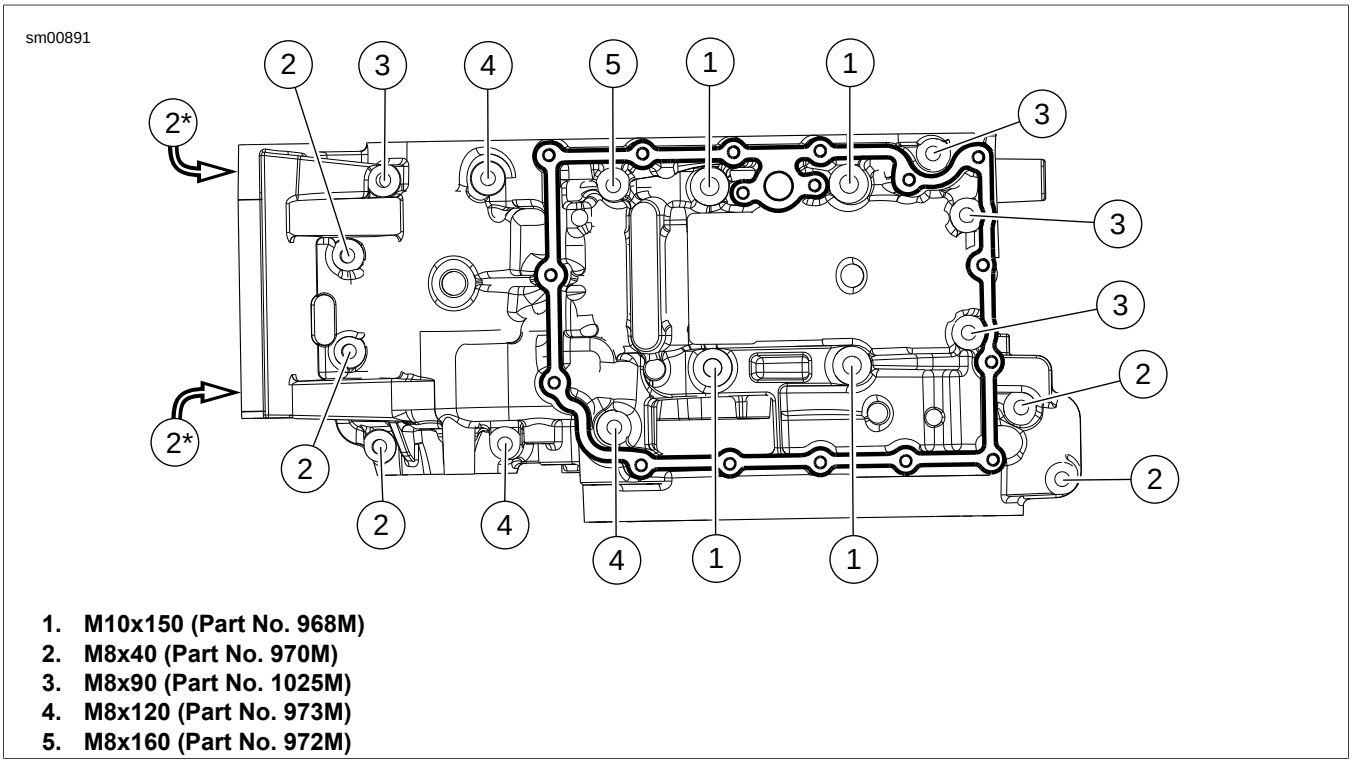


Figure 6-54. Lower Case Over Alignment Dowels



Figure 6-55. Marks Aligned

25. Verify that transmission input and output shafts spin freely.



1. **M10x150 (Part No. 968M)**
2. **M8x40 (Part No. 970M)**
3. **M8x90 (Part No. 1025M)**
4. **M8x120 (Part No. 973M)**
5. **M8x160 (Part No. 972M)**

Figure 6-56. Case Fastener Sizes (*Insert from upper case half)

26. See Figure 6-56. Match and install all 19 case fasteners.
27. See Figure 6-57. Tighten counterbalancer gear fastener to 50 Nm (37 ft-lbs) plus 90 degrees.

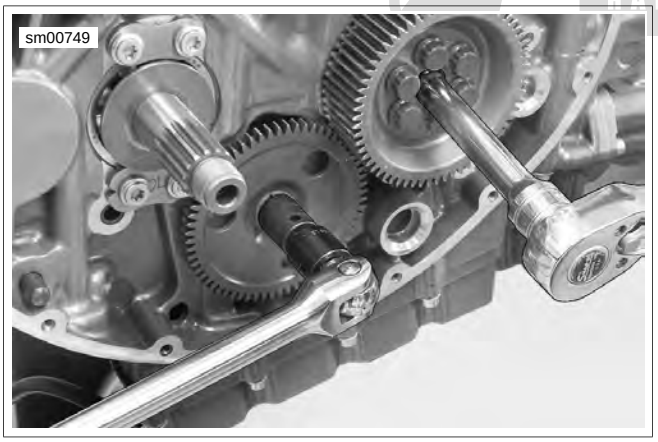


Figure 6-57. Tighten Counterbalancer Gear

NOTE

The correct torque sequence for the case fasteners requires 2 steps. First, all 19 case fasteners including the 4 main bearing bolts are tightened to 25 Nm (18.4 ft-lbs). Loosen bolts one full turn, tighten to second torque and then turn an additional 90 degrees. Refer to Table 6-5.

28. See Figure 6-59. Tighten all 19 case fasteners to 25 Nm (18.4 ft-lbs) in the sequence shown. Dab a marker next to each fastener to identify it is tightened.
29. Final tighten the main bearing bolts:
 a. Loosen each main bearing bolt in sequence (1, 2, 3, 4) one full turn.
 b. Tighten each main bearing bolt in sequence (1, 2, 3, 4) to 15 Nm (131 **in-lbs**).
 c. See Figure 6-58. Tighten main bearing bolts an additional 90 degrees using TORQUE ANGLE GAUGE (Part No. SNAP-ON TA360).
30. Dab a second mark next to each main bearing bolt to identify which bolts have been final tightened.

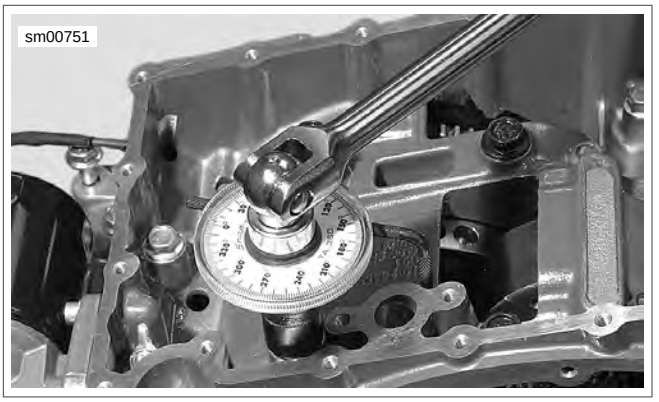
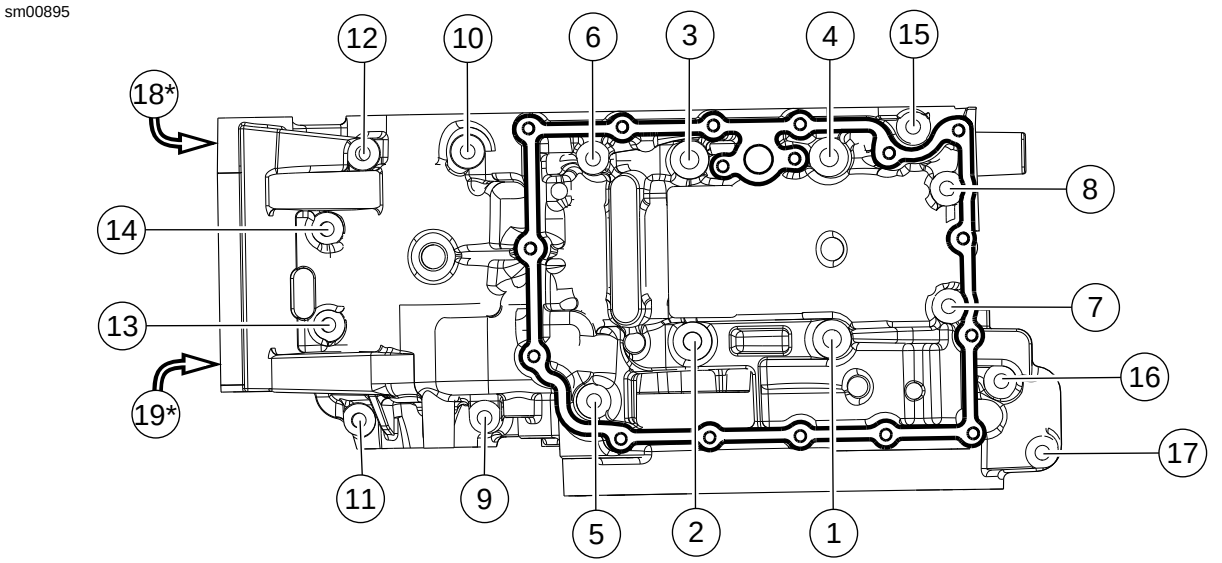


Figure 6-58. Torque Angle Gauge



1. **M10x150**
2. **M10x150**
3. **M10x150**
4. **M10x150**
5. **M8x120**
6. **M8x160**
7. **M8x90**
8. **M8x90**
9. **M8x120**
10. **M8x120**
11. **M8x40**
12. **M8x90**
13. **M8x40**
14. **M8x40**
15. **M8x90**
16. **M8x40**
17. **M8x40**
18. **M8x40 (*insert from upper case half)**
19. **M8x40 (*insert from upper case half)**

Figure 6-59. Engine Case Torque Sequence

Table 6-5. Engine Case Fastener Torque

FASTENER #	TORQUE	
	Nm	FT-LBS
1 through 19 (in sequence)	25	18.4
1, 2, 3, 4 (in sequence)	Loosen one full turn	
1, 2, 3, 4 (in sequence)	15	11
1, 2, 3, 4 (in sequence)	Tighten an additional 90 degrees	

31. See Figure 6-60. Tighten the upper and lower input bearing retainer fasteners to 23 Nm (17 ft-lbs).
32. See Figure 6-61. Install the two lower case drive sprocket flange seal retainer fasteners and tighten all four drive sprocket flange seal retainer fasteners to 23 Nm (17 ft-lbs).
33. See Figure 6-62. Place **new** oil pan gasket in position. Install oil pickup and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
34. See Figure 6-63. Install oil pan and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).

NOTE

See 3.12 ENGINE BOTTOM END SERVICE to continue engine rebuild.

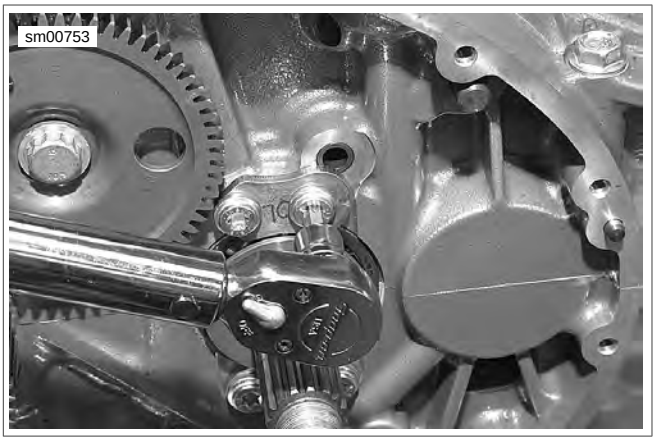


Figure 6-60. Input Bearing Retainer

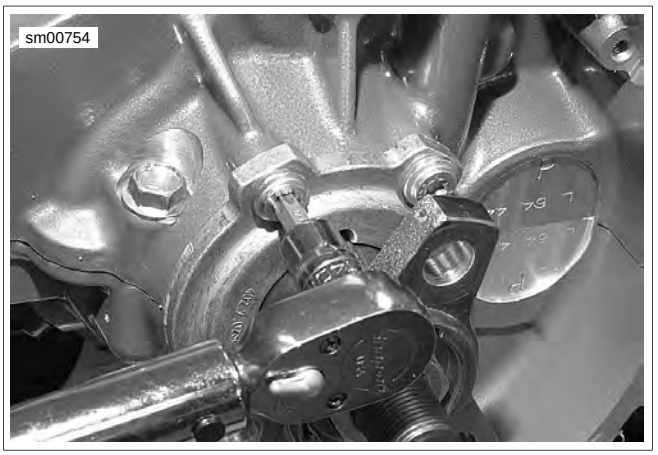


Figure 6-61. Drive Sprocket Flange Seal Retainer

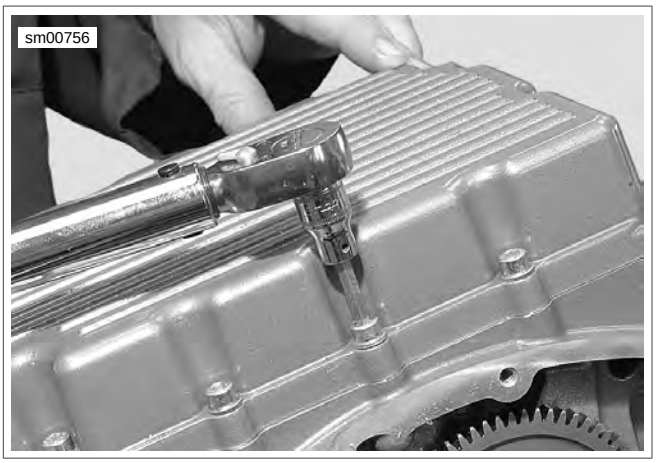


Figure 6-63. Oil Pan

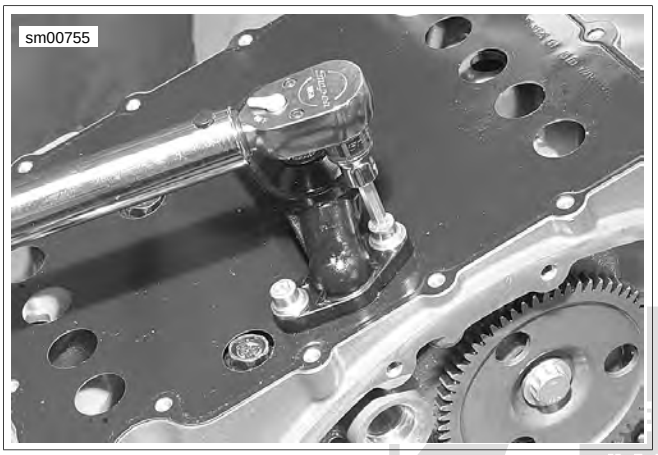


Figure 6-62. Oil Pickup

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COUNTERBALANCER BEARING REPLACEMENT 6.5

REMOVAL

PART NUMBER	TOOL NAME
HD-34902-B	BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER
HD-45490	BALANCER BEARING REMOVER/INSTALLER TOOLS
HD-46582	COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER
SNAP-ON SRPC3890	RETAINING RING PLIERS

NOTE

In order to break counterbalancer gear loose, it is necessary to hold the counterbalancer gear with the crankshaft drive gear. Once the fastener is loose, the engine case halves can be separated. See 6.4 TRANSMISSION.

1. See Figure 6-64. Before separating the case halves and removing the crankshaft, rotate engine clockwise until timing marks are aligned.

NOTICE

Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)

2. Hold crankshaft and loosen counterbalancer gear retaining fastener.
3. See Figure 6-65. Remove fastener and gently pry counterbalancer gear from shaft. Discard fastener.

NOTES

- *The counterbalancer gear retaining fastener is one-time-use only. Always use a **new** fastener when installing counterbalancer gear.*
- *Use RETAINING RING PLIERS (Part No. Snap-on SRPC3890) for removal and installation of the retaining rings.*

4. See Figure 6-66. Remove outer retaining ring.

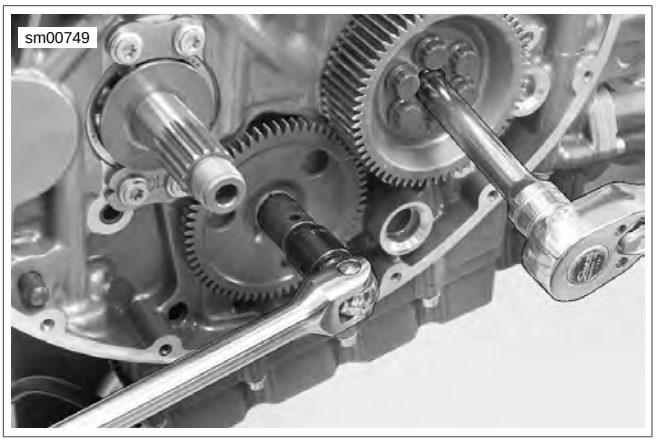


Figure 6-64. Tighten Counterbalancer Gear

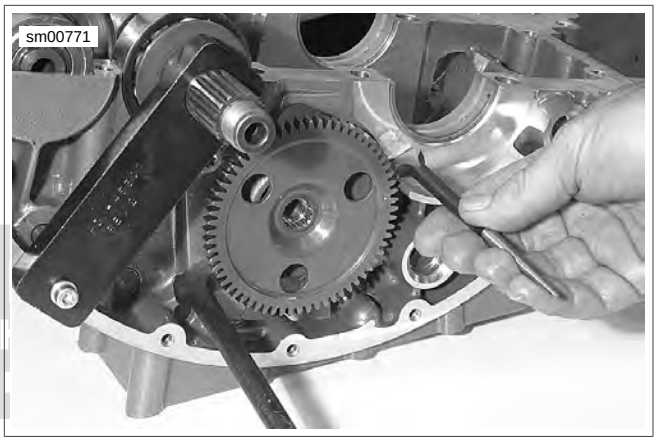


Figure 6-65. Remove Counterbalancer Gear

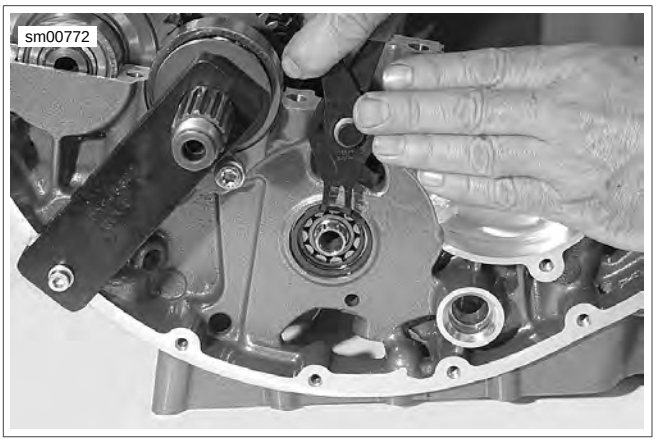


Figure 6-66. Remove Retaining Ring

5. See Figure 6-67. Thread end of BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490) into balancer shaft.
6. See Figure 6-68. Rotate counterweight and hold upright in the position shown to prevent binding against the case. The tool will pull the outboard bearing and balancer

through the case. When the bearing is free, remove tool and bearing.

7. See Figure 6-69. Remove counterbalancer from engine.

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

8. See Figure 6-70. Remove outboard inner retaining ring.



Figure 6-67. Counterbalancer Tool



Figure 6-68. Remove Counterbalancer Outboard Bearing



Figure 6-69. Remove Counterbalancer



Figure 6-70. Outboard Inner Retaining Ring

9. See Figure 6-72. Position the bearing removal insert as shown. Note the position of the flat.
10. See Figure 6-73. Thread puller rod into insert.
11. See Figure 6-74. Hold screw end of puller and turn large nut to remove the bearing.
12. See Figure 6-71. Remove inboard retaining ring.



Figure 6-71. Counterbalancer Inboard Retaining Ring

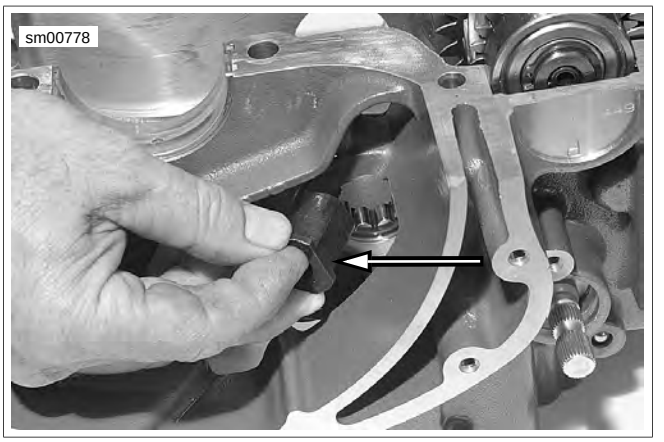


Figure 6-72. Bearing Removal Insert

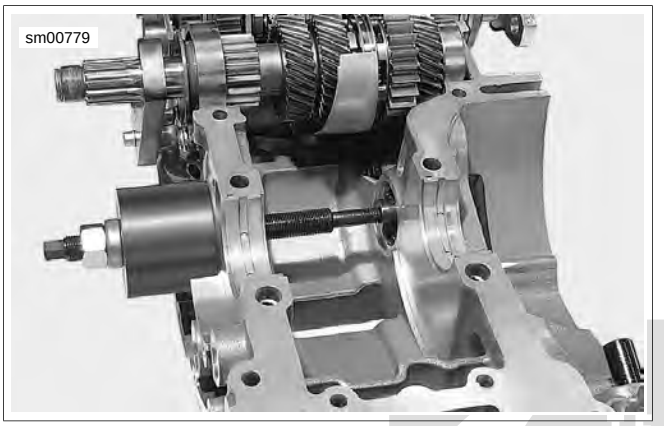


Figure 6-73. Position Puller

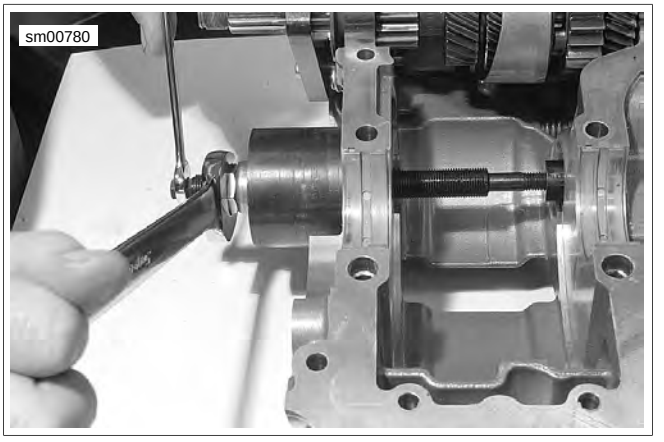


Figure 6-74. Remove Bearing

NOTE

ALWAYS replace the inner race when counterbalancer bearings are replaced.

13. See Figure 6-75. Fit the lower half of the COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER (Part No. HD-46582) with pin hole over back of inner race. Fit push screw into hole of lower puller half.
14. Position upper puller half around inboard inner bearing race. Slide connecting collar over the halves.
15. See Figure 6-76. Turn push screw to remove inboard bearing inner race.
16. See Figure 6-77. Using a HD-34902-7 tool from BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (Part No. HD-34902-B) position end cap over end of outboard of countershaft balancer shaft and remove the outboard bearing inner race.



Figure 6-75. Counterbalancer Bearing Inner Race Remover and Installer (HD-46582)

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Figure 6-76. Remove Bearing Race



Figure 6-77. End Cap from HD-34902-B

INSTALLATION

PART NUMBER	TOOL NAME
HD-45311	COUNTERBALANCER ALIGNMENT PIN
HD-45490	BALANCER BEARING REMOVER/INSTALLER TOOLS

FASTENER	TORQUE VALUE	
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs

1. See Figure 6-78. Press **new** inner race of inboard bearing even with the end of the counterbalancer.
2. See Figure 6-79. Press **new** outboard bearing race flush against the shoulder of the balancer.

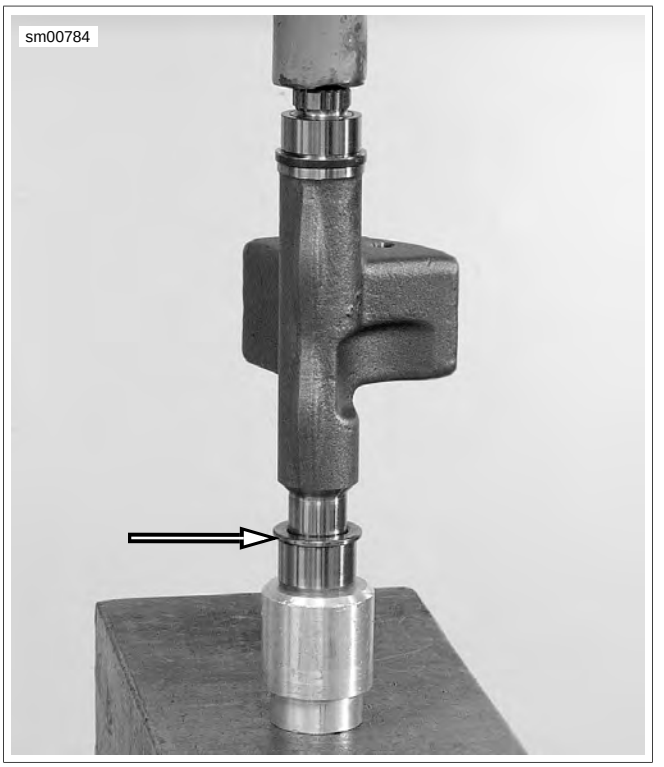


Figure 6-78. Inboard Bearing Race

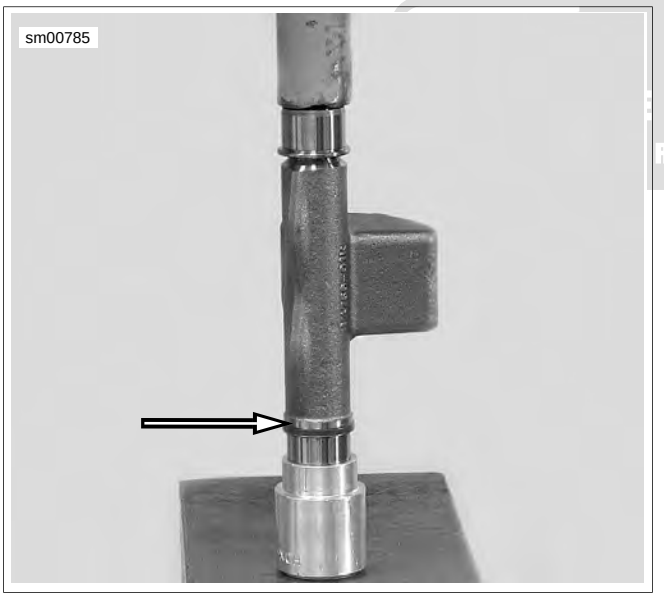
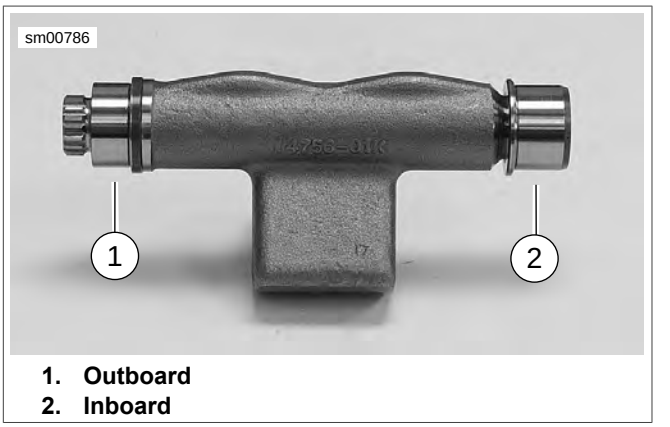


Figure 6-79. Outboard Bearing Race



1. **Outboard**
2. **Inboard**

Figure 6-80. Installed Inner Races

3. See Figure 6-80. Inboard bearing race (2) is even with the end of the counterbalancer shaft. Seat outboard bearing race (1) against shoulder of counterbalancer.

NOTES

- *Use GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation. Also use SCREAMIN' EAGLE ASSEMBLY LUBE on inner races.*
- *When installing bearings, always press against the side of the bearing with the manufacturer's lettering/part number.*

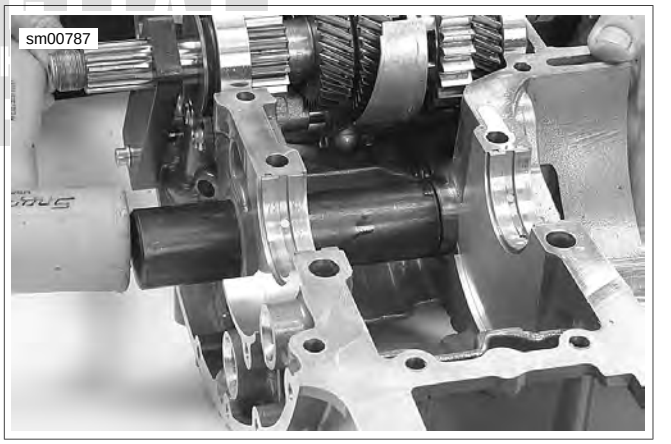


Figure 6-81. Inner Balancer Bearing Installation

4. See Figure 6-81. Using the bearing installer from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490), drive the inner counterbalancer bearing into the case with a soft faced hammer until the retaining ring groove is visible.
5. See Figure 6-82. Install inner retaining ring. Verify retaining ring is fully seated.
6. See Figure 6-83. Install outboard bearing inner retaining ring. Verify retaining ring is fully seated.
7. See Figure 6-84. Position counterbalancer in case.

NOTE

When installing bearings, always press against the side of the bearing with the manufacturer's lettering/part number.

8. See Figure 6-85. Start bearing by hand. Insert tapered guide from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490).

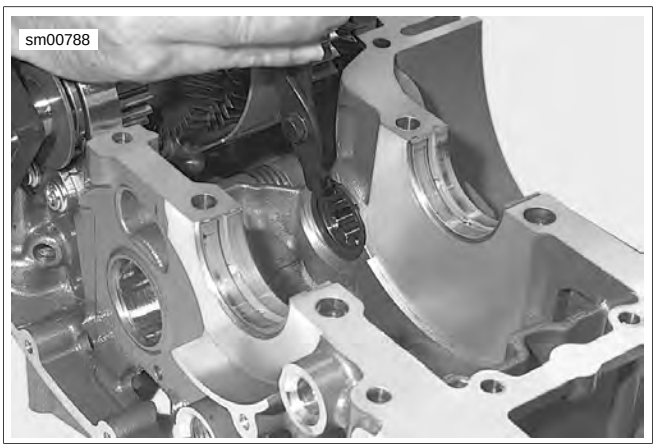


Figure 6-82. Inner Balancer Bearing Installation

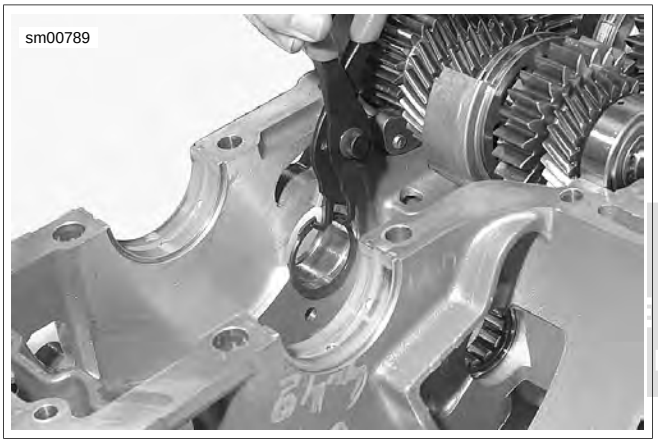


Figure 6-83. Outboard Bearing Inner Retaining Ring

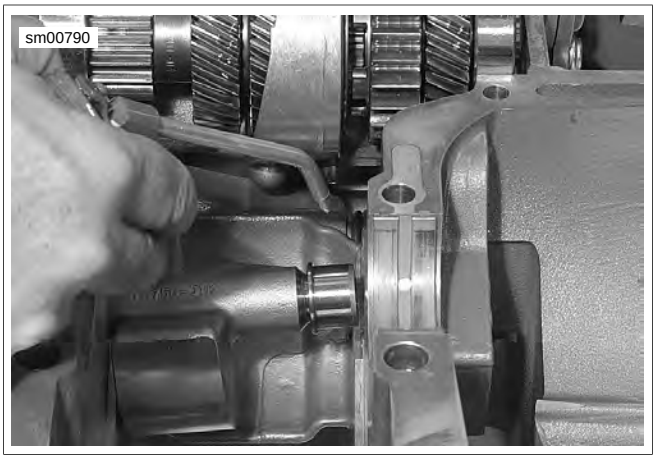


Figure 6-84. Position Counterbalancer

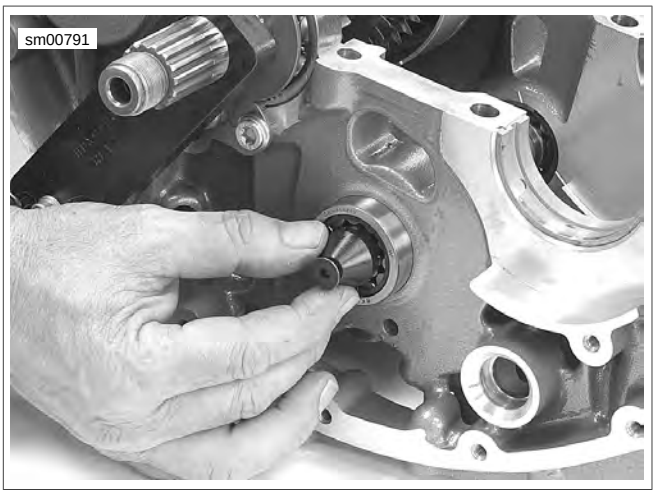


Figure 6-85. Insert Tapered Guide

9. See Figure 6-86. Use the driver from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490). Drive the bearing in with a soft faced hammer until the retaining ring groove is exposed.

10. See Figure 6-87. Install **new** outboard retaining ring. Verify retaining ring is fully seated in the case groove.

NOTE

Install counterbalancer gear with the counterbalancer gear fastener loosely holding the counterbalancer in place. The counterbalancer is either timed to the crankshaft during the assembly of the case halves, or after the case halves have been assembled.

11. See Figure 6-88. Position balancer shaft master tooth at 11 o'clock.

12. Insert COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).

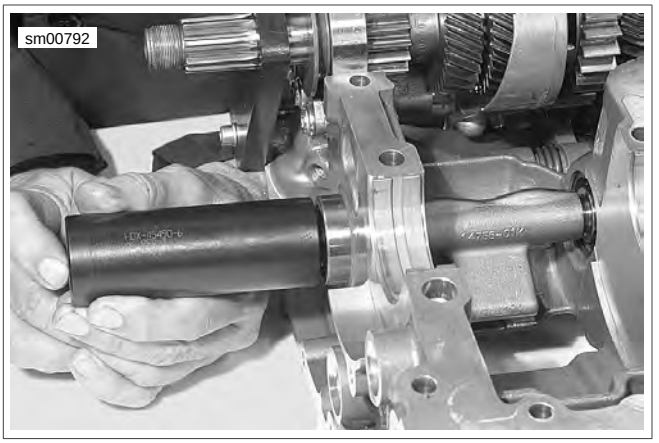


Figure 6-86. Outboard Bearing Installation

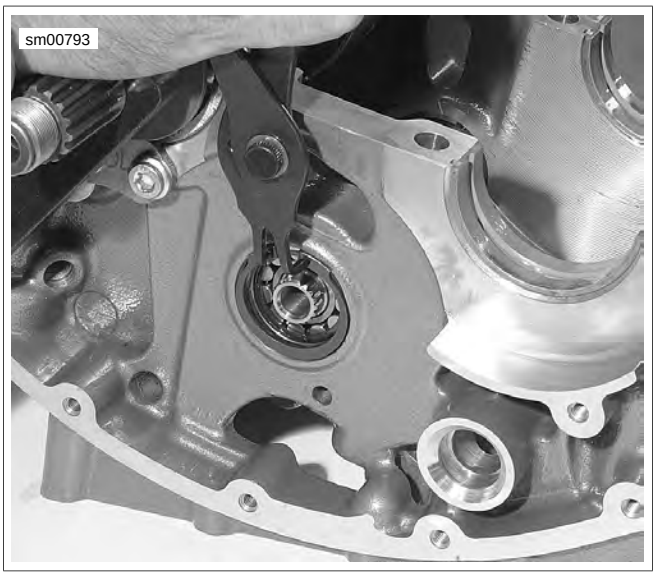


Figure 6-87. Outboard Retaining Ring Installation

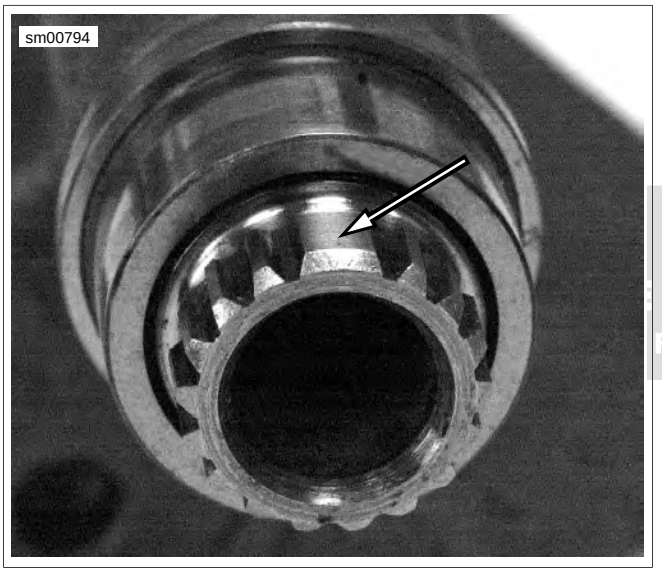


Figure 6-88. Counterbalancer Shaft Master Tooth

13. See Figure 6-90. Position counterbalancer gear with timing marks aligned to crankshaft drive gear.
14. See Figure 6-89. Align the master tooth flat with the corresponding master tooth on the balancer shaft.
15. Gently rock crankshaft until counterbalancer shaft master tooth engages counterbalancer gear master tooth flat and gear slides onto shaft. Gear should seat with hand pressure.

NOTICE

Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)

16. Remove COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).
17. Install a **new** counterbalancer gear fastener.
18. See Figure 6-91. Hold crankshaft while tightening counterbalancer gear fastener to 50 Nm (37 ft-lbs) plus 90 degrees.

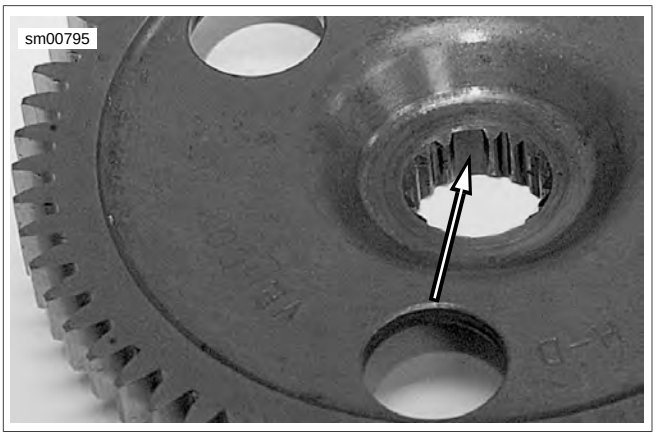


Figure 6-89. Counterbalancer Gear Master Tooth Flat



Figure 6-90. Timing Marks

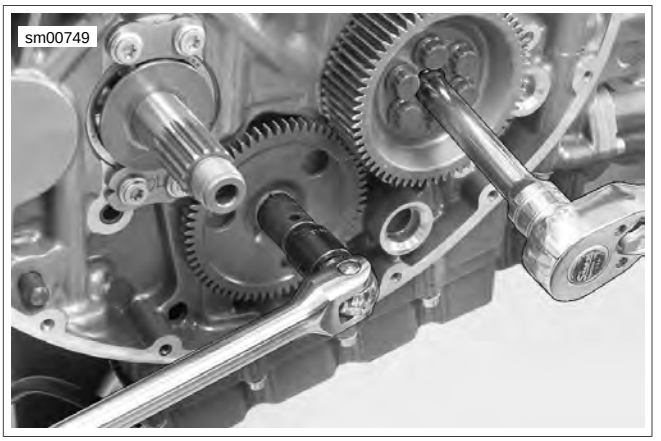


Figure 6-91. Tighten Counterbalancer Gear

SHIFT SHAFT AND SEAL 6.6

GENERAL

This procedure is shown with the engine removed. The shift shaft and seal may be replaced without removing the engine from the chassis.

REMOVAL

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 6-92. Remove the outer retaining ring (zinc plated).
2. See Figure 6-93. Drill small hole in the shift shaft seal. Thread sheet metal screw into the hole.
3. See Figure 6-94. Gently pry seal from engine case.

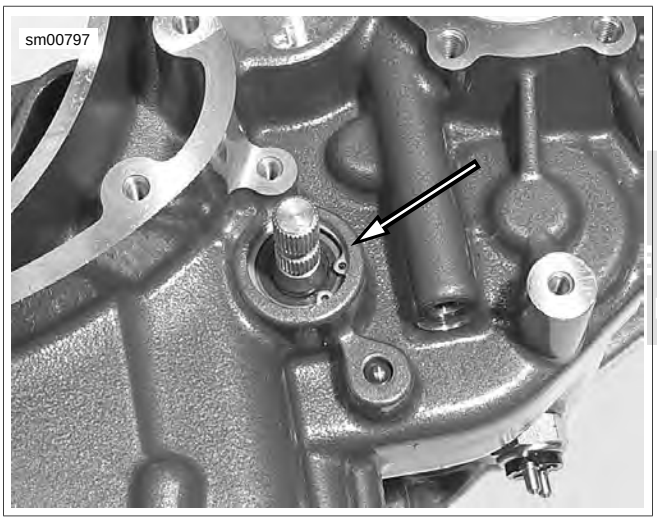


Figure 6-92. Shift Shaft Outer Retaining Ring

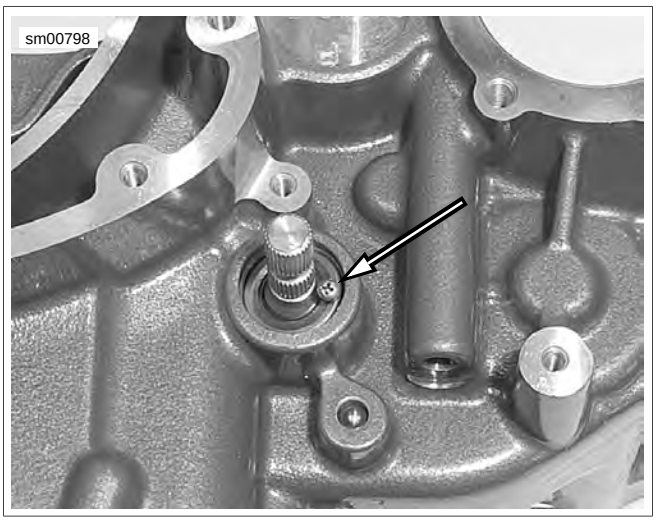


Figure 6-93. Shift Shaft Seal

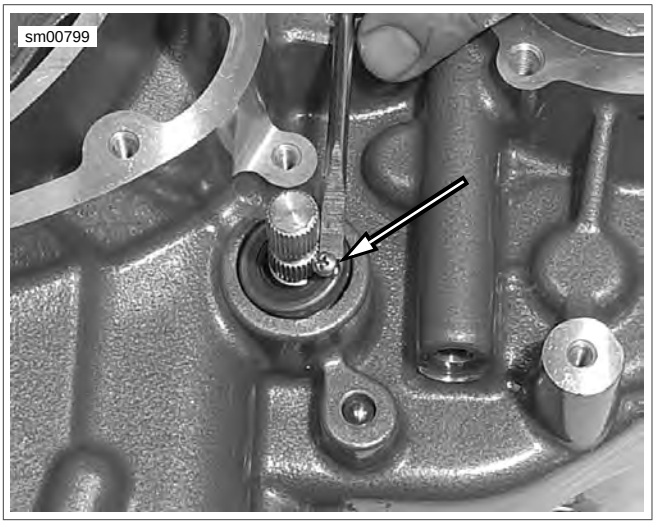


Figure 6-94. Remove Shift Shaft Seal

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

4. See Figure 6-95. With the shaft seal removed, the inner retaining ring (black) is exposed. Remove the retaining ring.
5. Remove shift shaft using hand effort.

NOTE

Be careful during shift shaft removal not to allow actuator to move out of place as the return spring can become disengaged. Disengagement of return spring will require engine removal and splitting of the crankcase to restore return spring to original state.

6. See Figure 6-96. The shift actuator is spring loaded and will move out of alignment with the case hole when the shift shaft is removed.

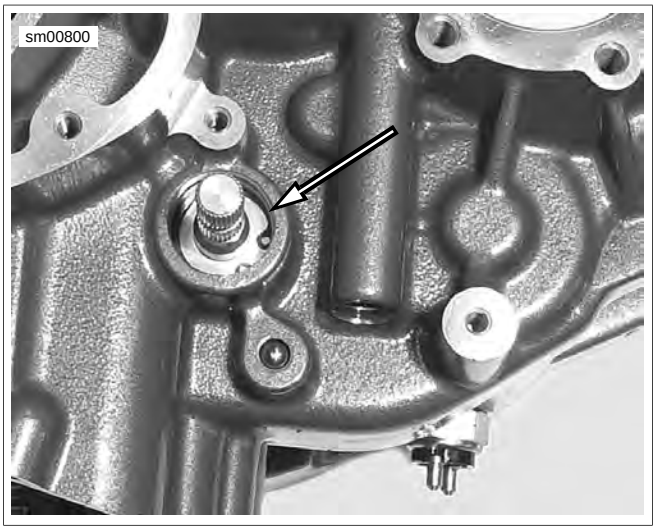


Figure 6-95. Shift Shaft Inner Retaining Ring

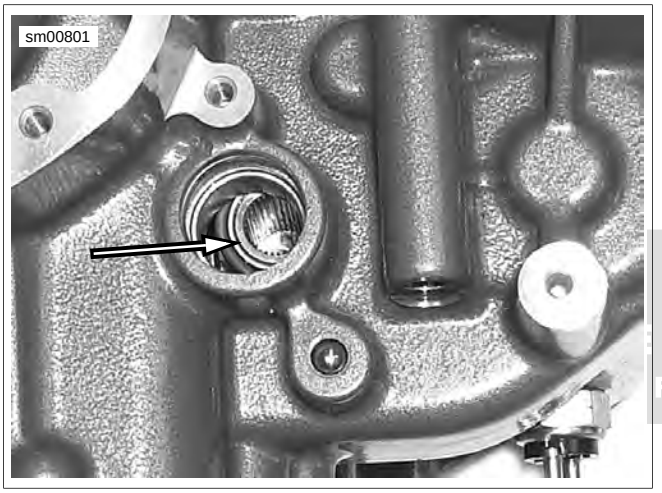


Figure 6-96. Shift Actuator

INSTALLATION

PART NUMBER	TOOL NAME
HD-45337	SHIFT SHAFT SEAL INSTALLER

1. See Figure 6-97. To insert shift shaft, use leading end of shift shaft to engage the shift actuator. Using hand pressure, center the shift shaft to engage the actuator splines. Seat shift shaft deep enough to expose inner retaining ring groove.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

NOTE

The inner (black) retaining ring and the outer (zinc plated) retaining ring are different in size by 1 mm (0.04 in.).

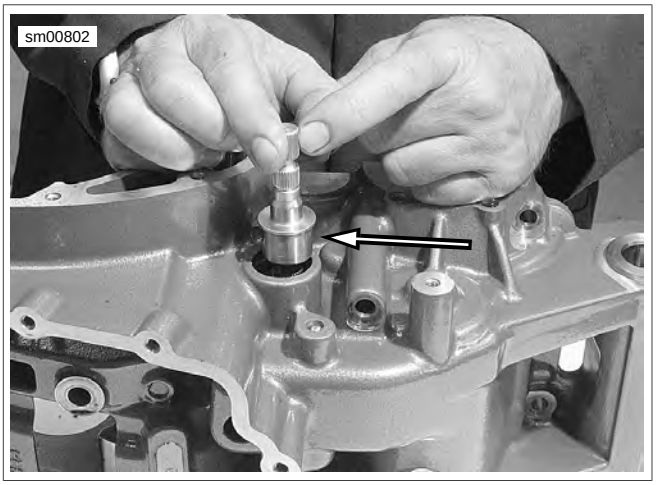


Figure 6-97. Shift Shaft Installation

2. Insert inner retaining ring (black).
3. See Figure 6-98. Lubricate shift shaft seal with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50 and insert using SHIFT SHAFT SEAL INSTALLER (Part No. HD-45337).
4. Install outer retaining ring (zinc plated).

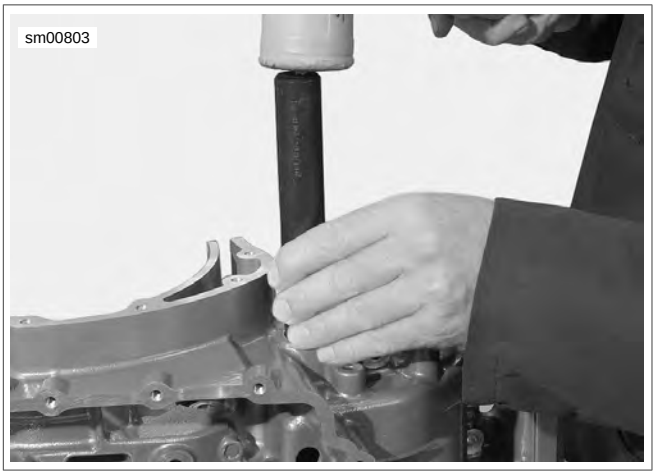


Figure 6-98. Shift Shaft Seal Installation

OUTPUT SHAFT 6.7

GENERAL

This procedure starts with the input shaft and output shaft removed from the engine. See 3.11 UPPER AND LOWER CRANKCASE SEPARATION for removal of input shaft and output shaft.

DISASSEMBLY: 2ND GEAR END

PART NUMBER	TOOL NAME
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL
HD-45332	FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER
SNAP-ON CJ2001	METRIC BOLT GRIP PULLER SET

FASTENER	TORQUE VALUE	
Flange nut, drive sprocket	160 Nm	118 ft-lbs

Bearing Removal: 2nd Gear End

1. See Figure 6-99. Remove lock ring from output flange nut.
2. See Figure 6-100. Install output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) and remove the output shaft nut. Use a 30 mm socket cut down to 39.6 mm (1.56 in.) outer diameter to clear the flange.

NOTE

Output flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.

3. See Figure 6-101. Obtain three 3/8 x 5 inch bolts with washers and nuts and install a METRIC BOLT GRIP PULLER SET (Part No. Snap-on CJ2001) onto the flange and shaft. Remove output shaft drive flange and seal retainer.
4. See Figure 6-102. Remove output shaft bearing.

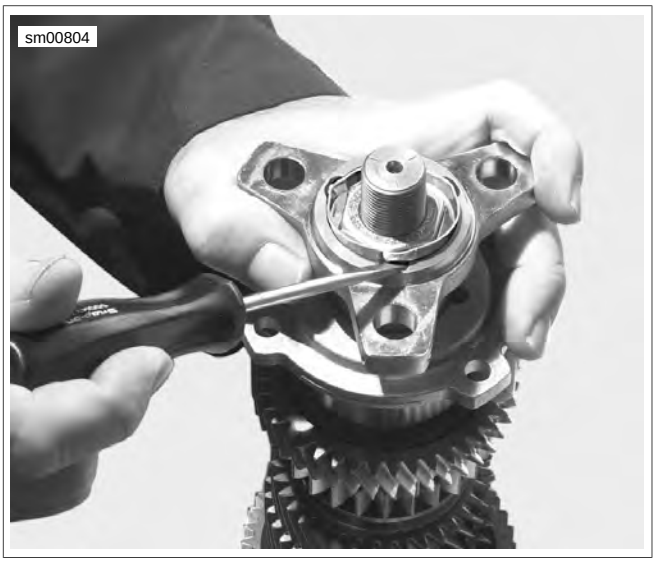


Figure 6-99. Output Shaft Lock Ring

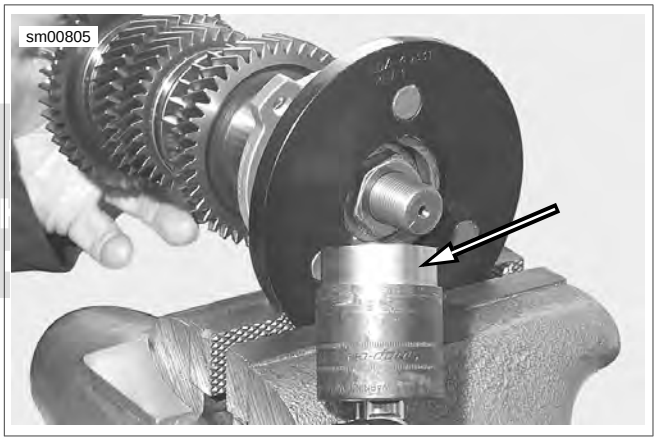


Figure 6-100. Modify Socket for Output Nut Removal

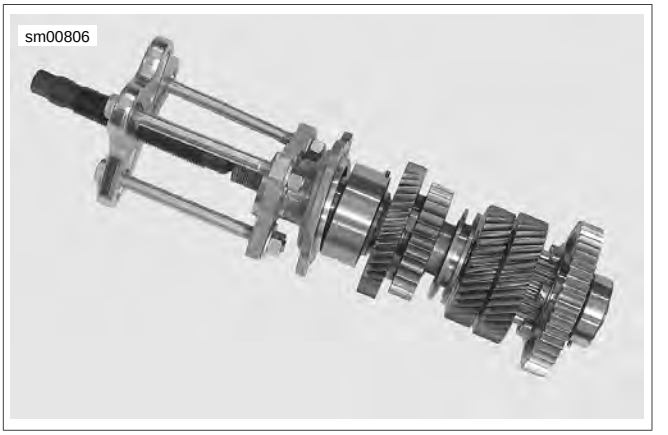


Figure 6-101. Removing Output Drive Flange

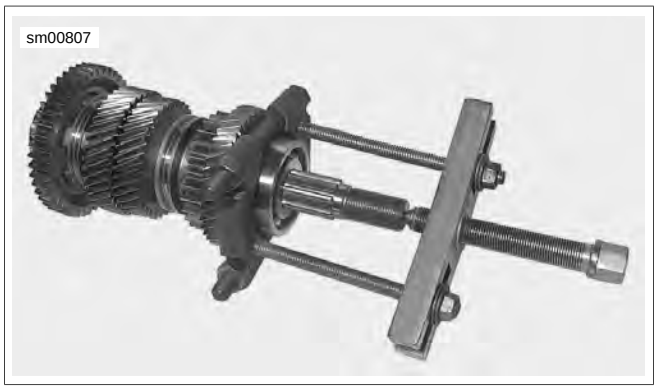


Figure 6-102. Output Shaft Bearing

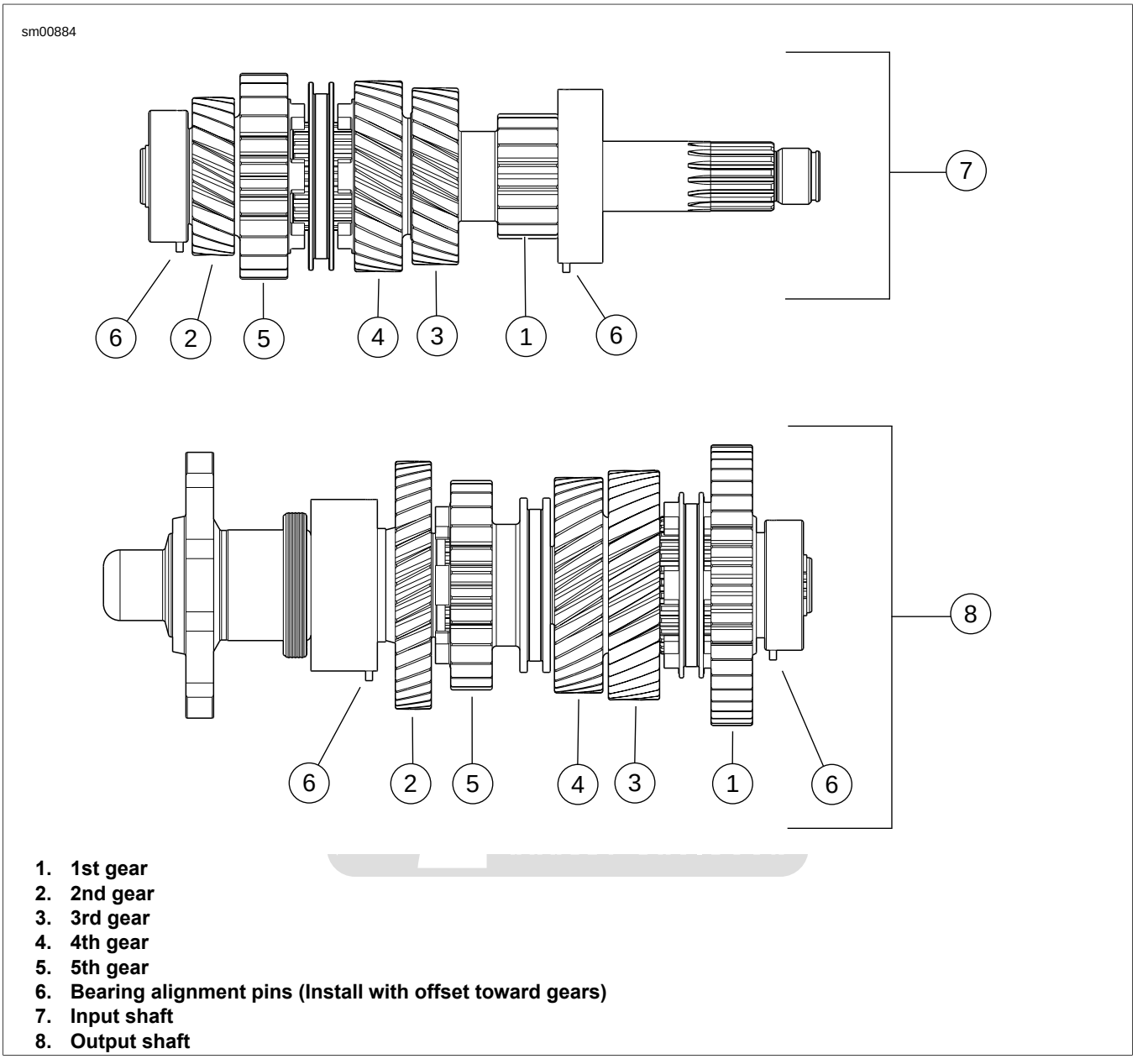
Bearing Installation: 2nd Gear End

1. See Figure 6-103 and Figure 6-104. Lubricate **new** bearing. Position bearing on shaft with bearing alignment pin offset toward gears and press onto shaft. Use a pressing ring so installation force is on the inner race only.



Figure 6-103. Output Shaft Bearing

DIGITAL TECHNICIAN II HARLEY-DAVIDSON



1. **1st gear**
2. **2nd gear**
3. **3rd gear**
4. **4th gear**
5. **5th gear**
6. **Bearing alignment pins (Install with offset toward gears)**
7. **Input shaft**
8. **Output shaft**

Figure 6-104. Transmission Input Shaft and Output Shaft Assemblies

2. See Figure 6-105. Replace flange seal and O-ring. Lubricate the flange seal with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50.
3. See Figure 6-106. Slide seal retainer on the output flange.
4. Install output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) and install the output shaft nut.

NOTE

Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.

5. Use the old output shaft nut to pull the output flange on the shaft.
6. See Figure 6-107. Remove and discard the old output shaft nut.



1. **Drive flange seal**
2. **O-ring**

Figure 6-105. Seal Retainer



Figure 6-106. Seal Retainer and Output Flange

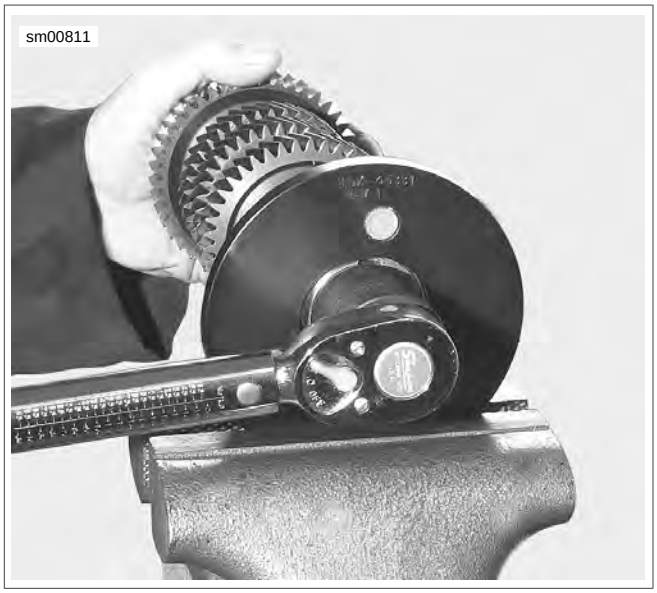
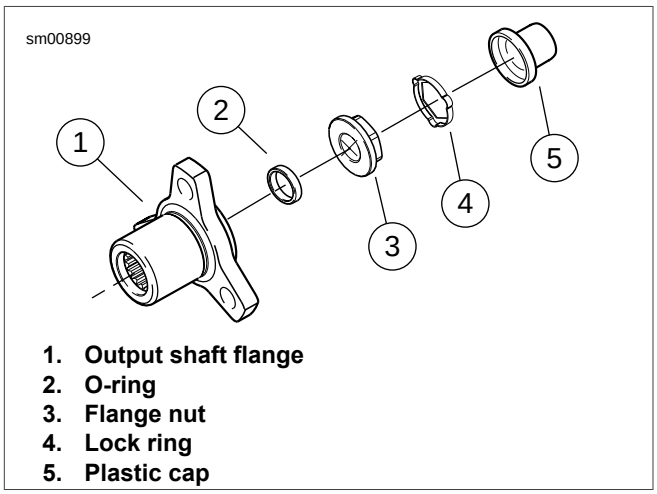


Figure 6-107. Remove/Tighten Output Shaft Nut

7. See Figure 6-108. Install a **new** O-ring (2) behind a **new** drive sprocket flange nut (3) and install the **new** flange nut (3). Tighten nut to 160 Nm (118 ft-lbs).
8. Position lock ring (4) over flange nut (3).
9. See Figure 6-109. With three 3/8 x 5 inch bolts with washers and nuts and install a METRIC BOLT GRIP PULLER SET (Part No. Snap-on CJ2001) onto the flange and shaft. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332) to crimp lock ring in position.
10. See Figure 6-108. Install plastic cap (5).

NOTE

Never use a hammer to hit on the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332). Damage to output shaft bearing could result.



1. **Output shaft flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

Figure 6-108. Output Shaft Components

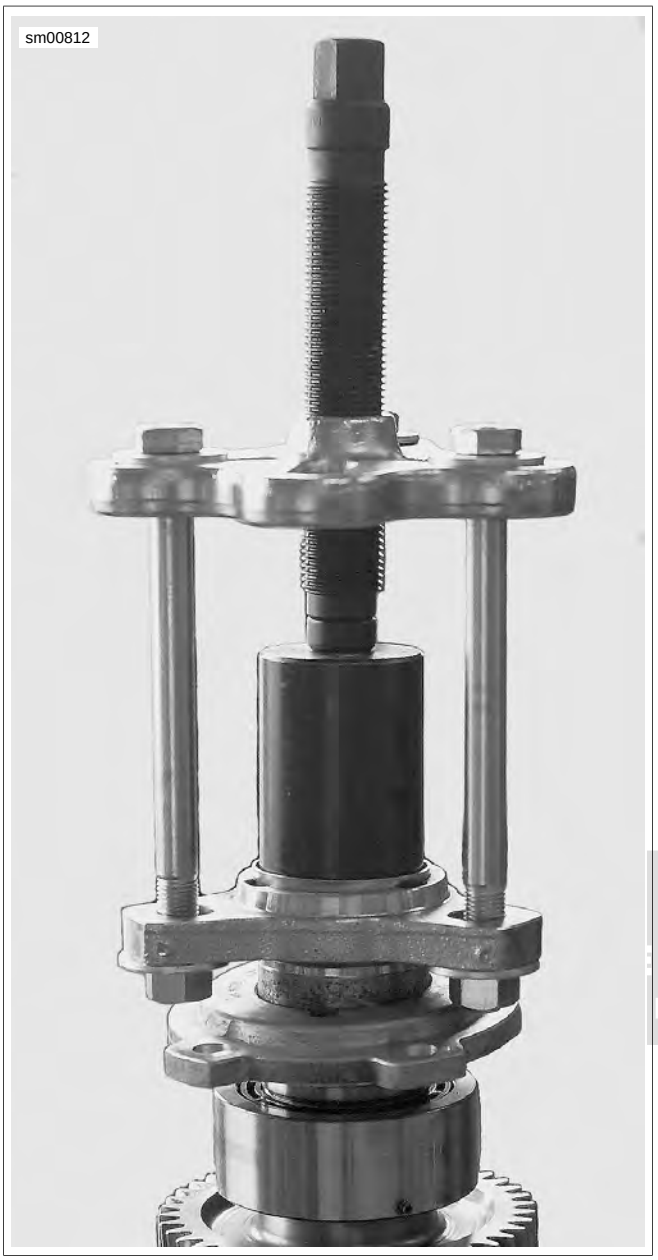


Figure 6-109. Crimping Output Shaft Nut Lock-Ring

11. See Figure 6-110. Remove ground washer.
12. See Figure 6-111. Remove 2nd gear.
13. See Figure 6-112. Remove split cage bearing and hardened washer.
14. See Figure 6-113. Remove 5th gear.

NOTE

Fourth gear is part of output shaft and is not removable. Damage to 4th gear requires replacement of the output shaft.



Figure 6-110. Remove Ground Washer

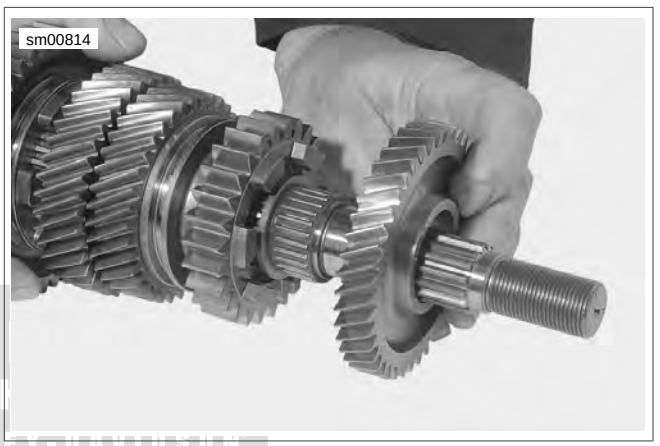


Figure 6-111. 2nd Gear



Figure 6-112. Bearing and Washer

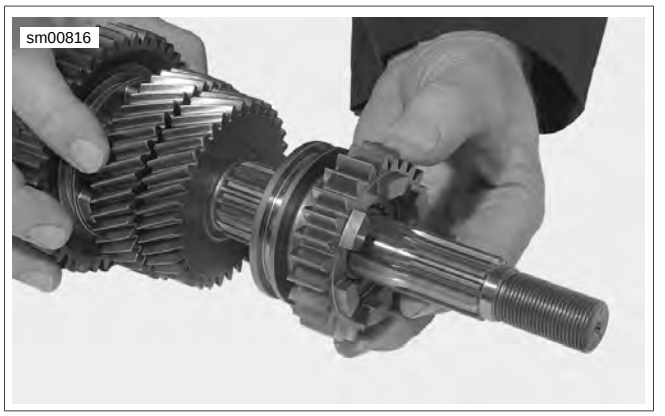


Figure 6-113. 5th Gear

ASSEMBLY: 2ND GEAR END

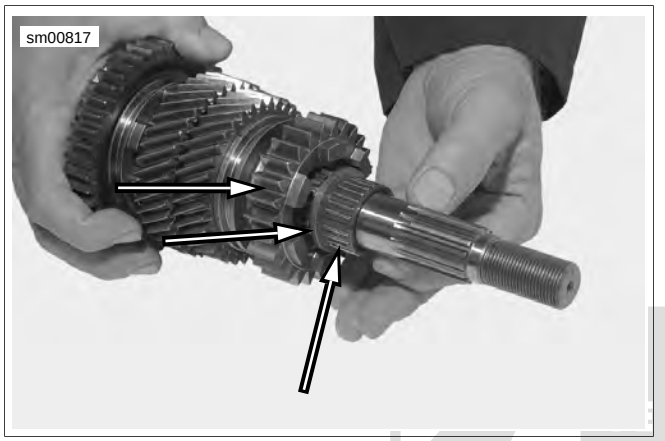


Figure 6-114. 5th Gear Installation

1. See Figure 6-114. Install 5th gear ground washer and split cage bearing.

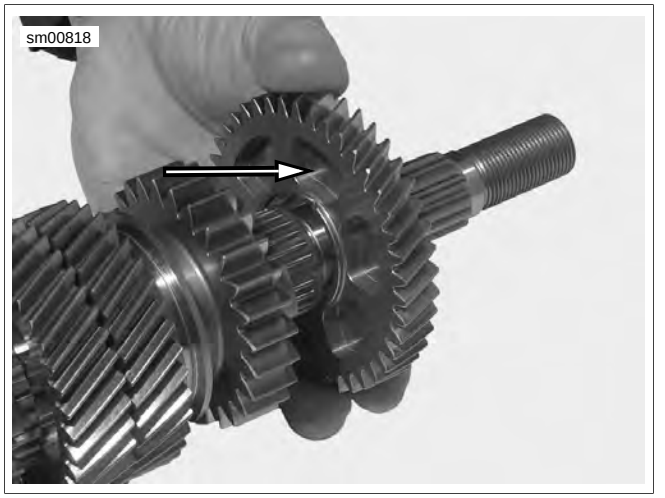


Figure 6-115. 2nd Gear Installation

2. See Figure 6-115. Install 2nd gear. Note 2nd gear pockets are installed toward the 5th gear engagement dogs.

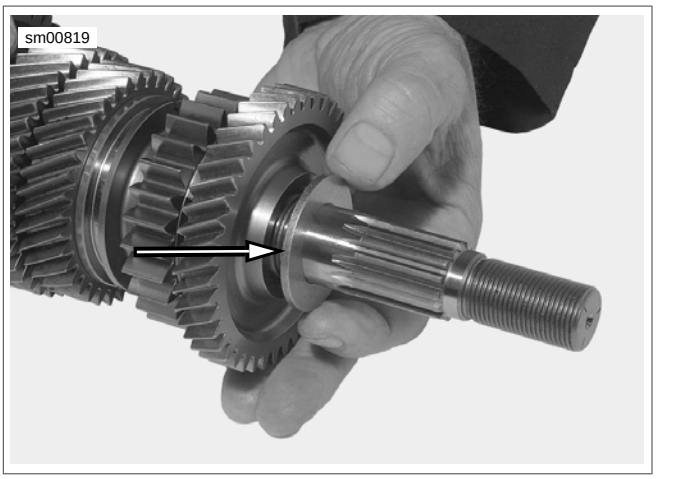


Figure 6-116. Hardened Washer

3. See Figure 6-116. Install hardened washer.
4. To complete output shaft assembly - 2nd gear end, see 6.8 INPUT SHAFT, Disassembly: 2nd Gear End.

Bearing Removal: 1st Gear End



Figure 6-117. 1st Gear Bearing Retaining Ring

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 6-117. Remove the retaining ring from the 1st gear bearing end of the output shaft.



Figure 6-118. 1st Gear Bearing Removal

2. See Figure 6-118. Remove and discard 1st gear bearing.

NOTE

Once removed, transmission bearings MUST be replaced.

Bearing Installation: 1st Gear End

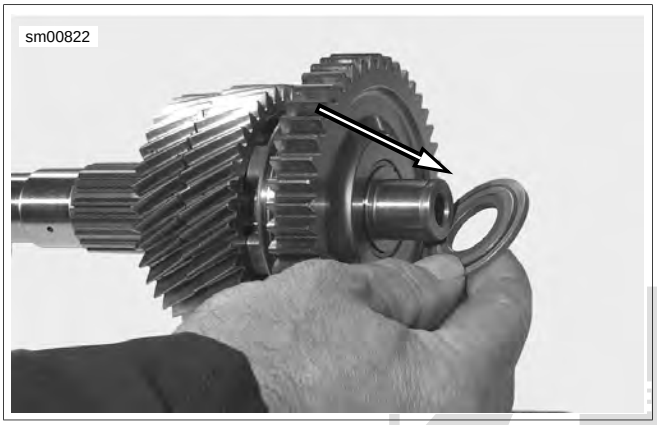


Figure 6-119. Thrust Washer

1. See Figure 6-119. Check position of stepped thrust washer. Step should face 1st gear, flat side toward bearing.

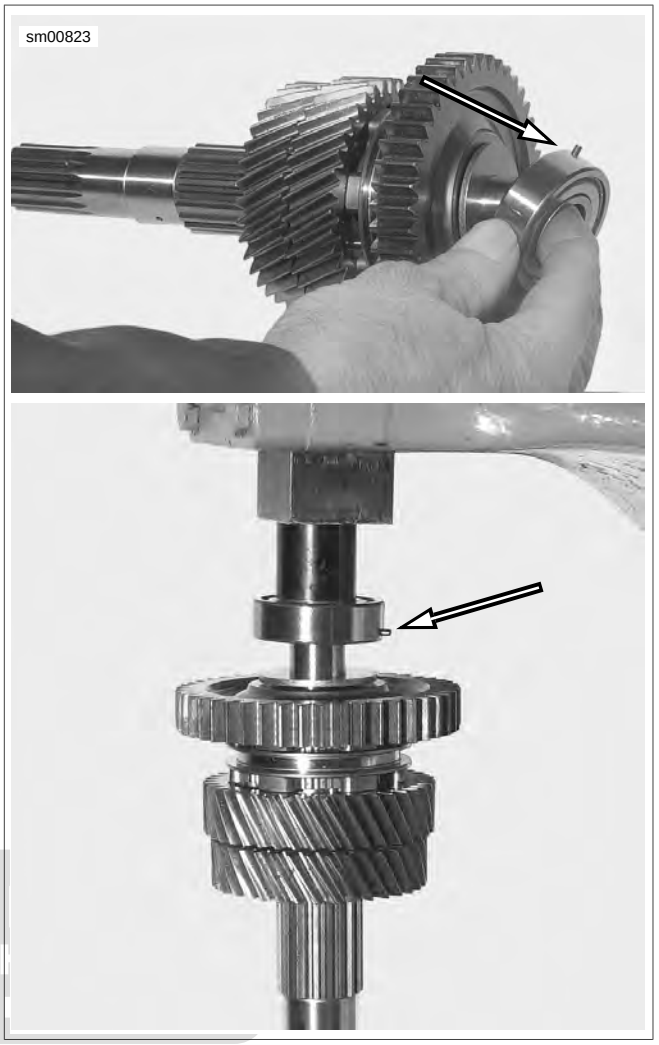


Figure 6-120. 1st Gear Bearing Installation

2. See Figure 6-120. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

3. Install retaining ring.
4. See Figure 6-104. Remove stepped washer and 1st gear (1).

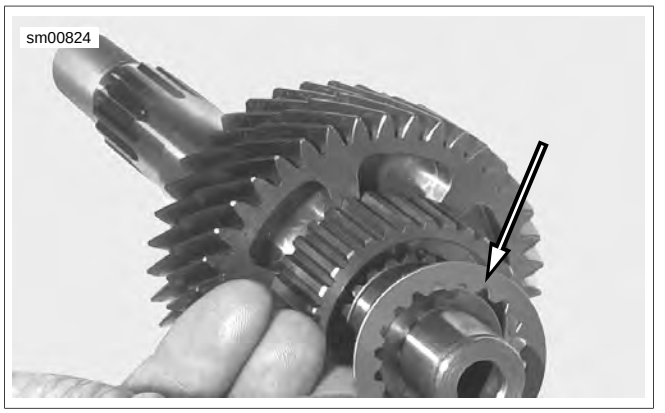


Figure 6-121. Splined Washer

5. See Figure 6-121. Remove splined washer.

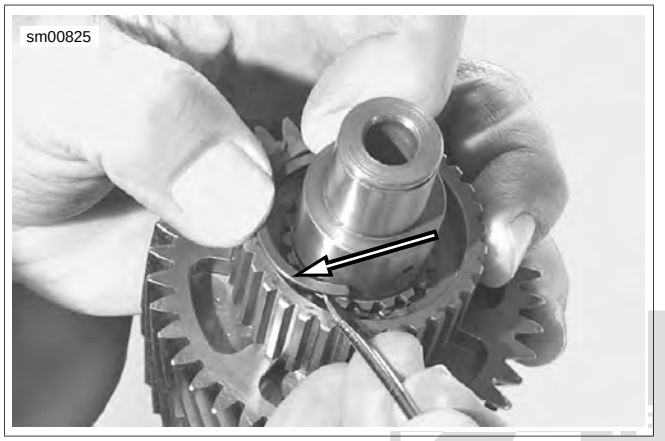


Figure 6-122. Half Moon Keepers

6. See Figure 6-122. Remove the half moon keepers.
7. See Figure 6-123. Remove the splined slider.
8. See Figure 6-124. Remove half moon keepers.
9. See Figure 6-125. Remove 3rd gear and split cage needle bearing.

NOTE

Fourth (4th) gear is part of the output shaft and is not removable.



Figure 6-123. Splined Slider

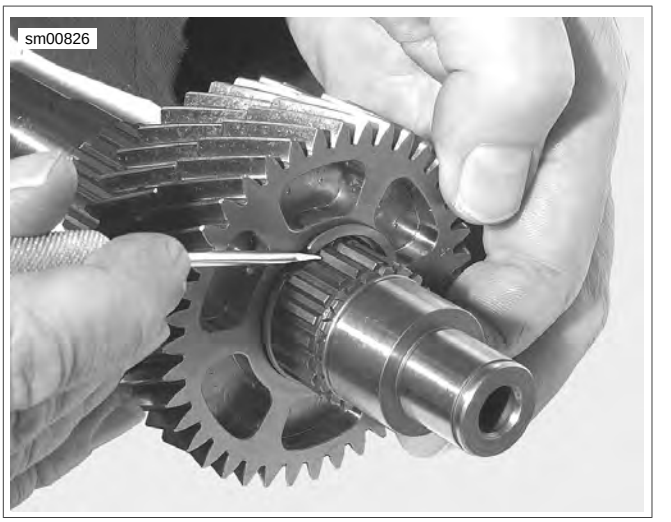


Figure 6-124. Half Moon Keepers



Figure 6-125. 3rd Gear

ASSEMBLY: 1ST GEAR END

Carefully clean and inspect parts to be reused. Examine gears for cracks, chipping and excessive wear.

1. See Figure 6-126. Install split cage needle bearing. Install 3rd gear.
2. See Figure 6-128. Install half moon keepers.
3. See Figure 6-128. Install splined slider.
4. See Figure 6-129. Install half moon keepers.



Figure 6-126. 3rd Gear



Figure 6-127. Half Moon Keepers



Figure 6-128. Splined Slider



Figure 6-129. Half Moon Keepers

5. See Figure 6-130. Install splined thrust washer with flat side out as shown.
6. See Figure 6-131. Install shift fork slider.
7. See Figure 6-132. Install 1st gear.
8. To complete output shaft assembly for 1st gear end, go to Bearing Installation: First Gear End.

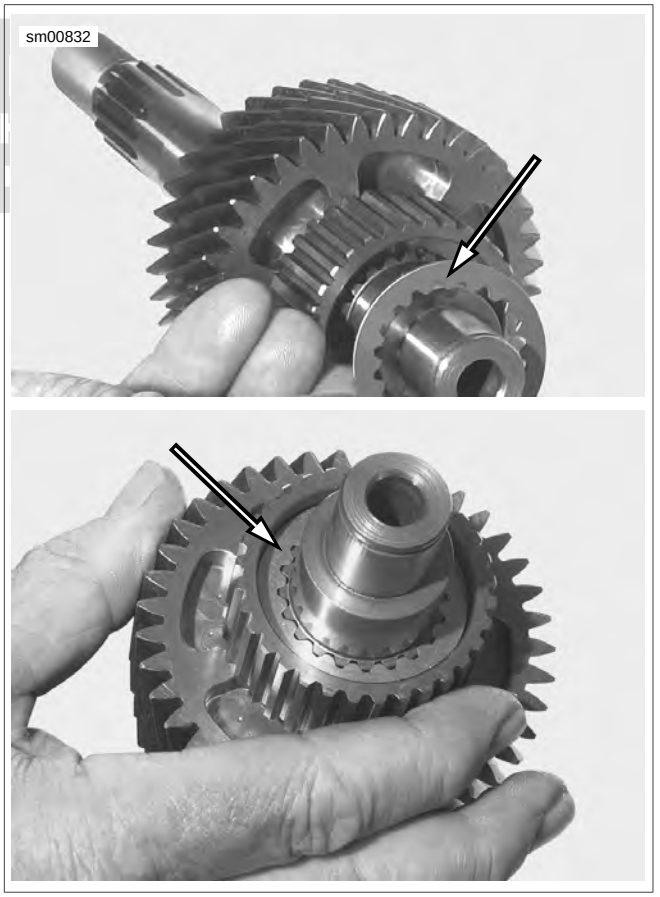


Figure 6-130. Splined Thrust Washer



Figure 6-131. Shift Fork Slider



Figure 6-132. 1st Gear

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

INPUT SHAFT 6.8

DISASSEMBLY: 2ND GEAR END

PART NUMBER	TOOL NAME
HD-34902-B	BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER

Bearing Removal: 2nd Gear End

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 6-133. Remove retaining ring at 2nd gear crankcase bearing.



Figure 6-133. 2nd Gear Bearing Retaining Ring

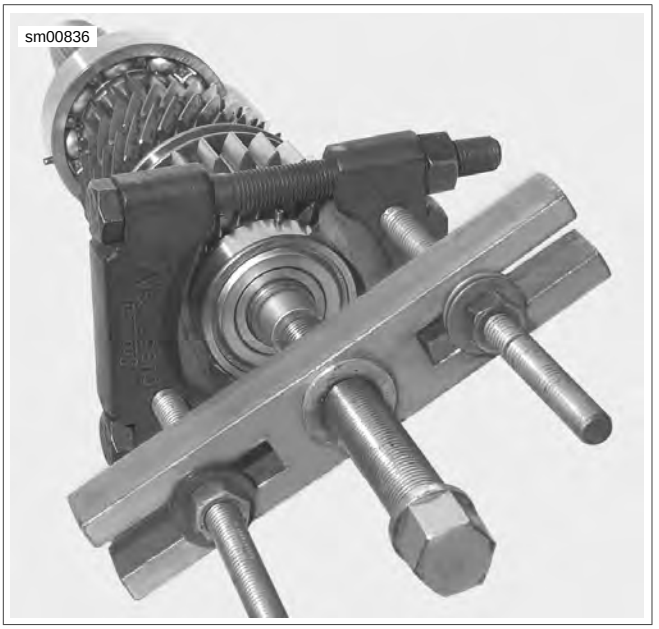


Figure 6-134. 2nd Gear Bearing Removal

2. See Figure 6-134. Use puller to remove 2nd gear bearing. To protect the end of the shaft use BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (Part No. HD-34902-B).

Bearing Installation: 2nd Gear End

1. See Figure 6-135. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)



Figure 6-135. 2nd Gear Bearing Alignment Pin



Figure 6-136. 2nd Gear Bearing Retaining Ring

2. See Figure 6-136. Install retaining ring.

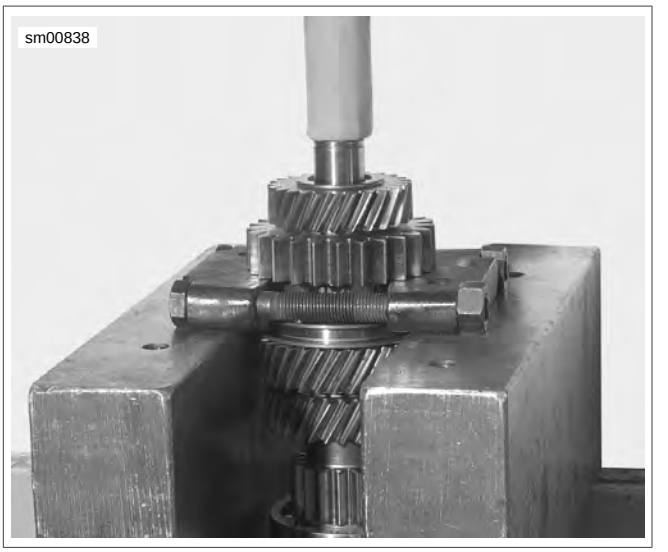


Figure 6-137. 2nd and 5th Gear Removal

3. See Figure 6-137. Place a puller clamp behind 5th gear and press off 2nd and 5th gear. Support the input shaft when removing the gears.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft regardless of its condition.

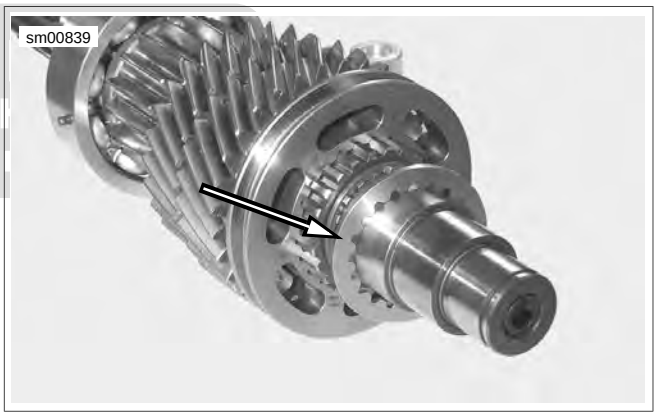


Figure 6-138. Splined Thrust Washer

4. See Figure 6-138. Remove the splined thrust washer.

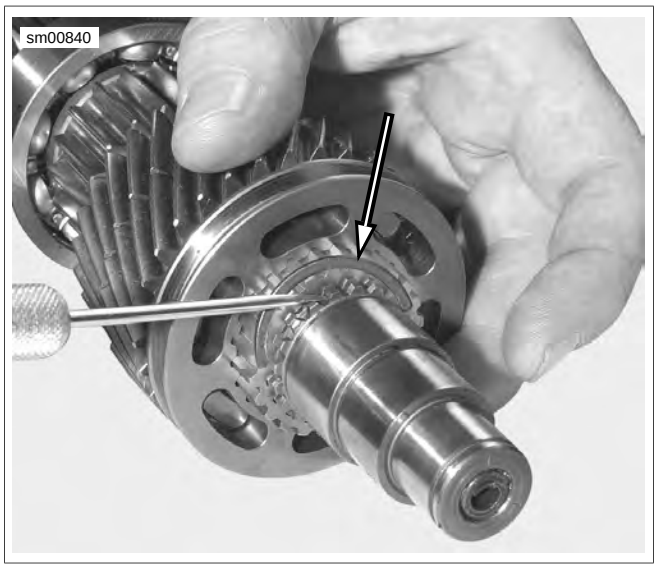


Figure 6-139. Half Moon Keepers

5. See Figure 6-139. Remove half moon keepers.

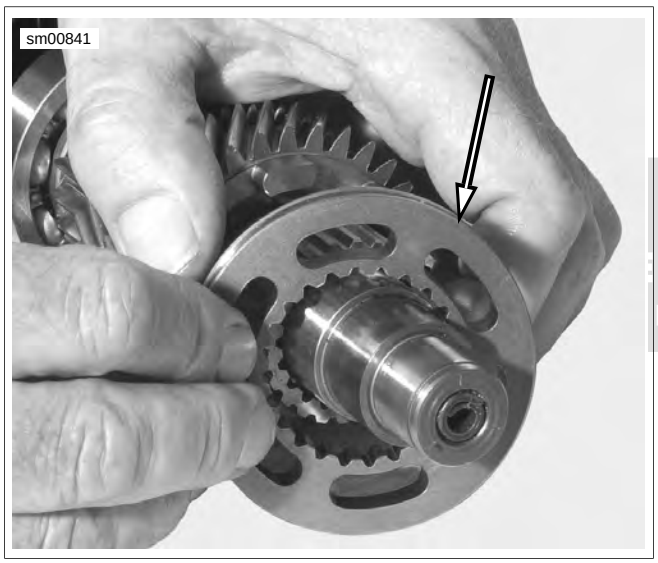


Figure 6-140. Shifting Fork Ring

6. See Figure 6-140. Remove shifting fork ring.

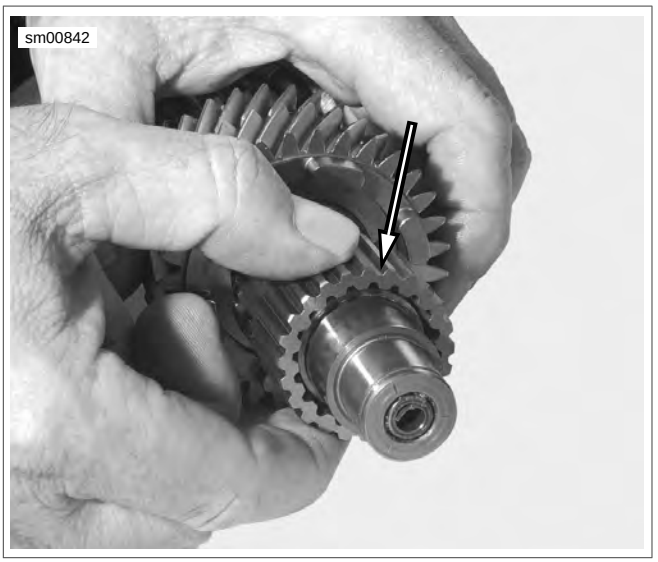


Figure 6-141. Splined Slider

7. See Figure 6-141. Remove splined slider.

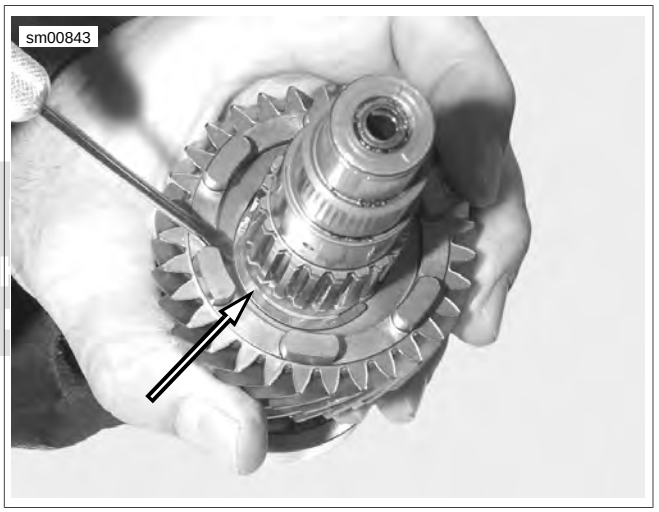


Figure 6-142. Half Moon Keepers

8. See Figure 6-142. Remove half moon keepers.

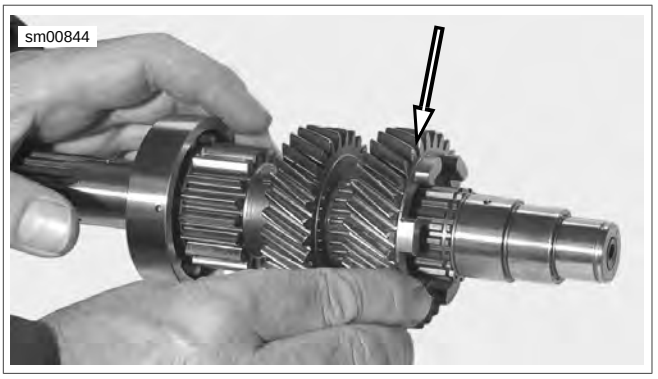


Figure 6-143. 4th Gear

9. See Figure 6-143. Remove 4th gear.

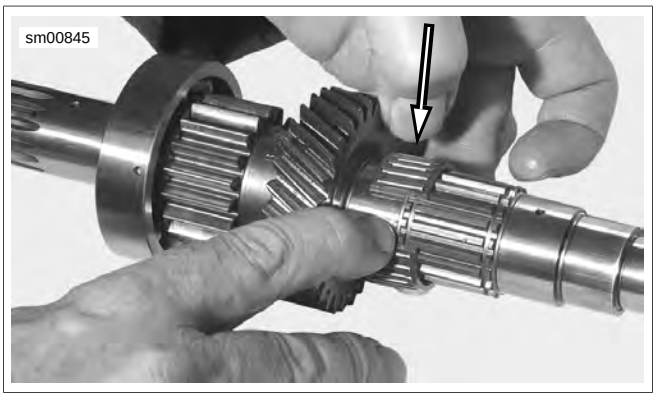


Figure 6-144. Split Cage Bearing

10. See Figure 6-144. Remove split cage bearing.

NOTE

See Figure 6-104. 1st gear and 3rd gear are part of the input shaft assembly and are not removable. Damage to 1st or 3rd gear requires replacement of the input shaft.

ASSEMBLY: 2ND GEAR END

1. See Figure 6-145. Lubricate **new** split cage bearing and position on shaft. Install 4th gear and place half moon keepers in position.

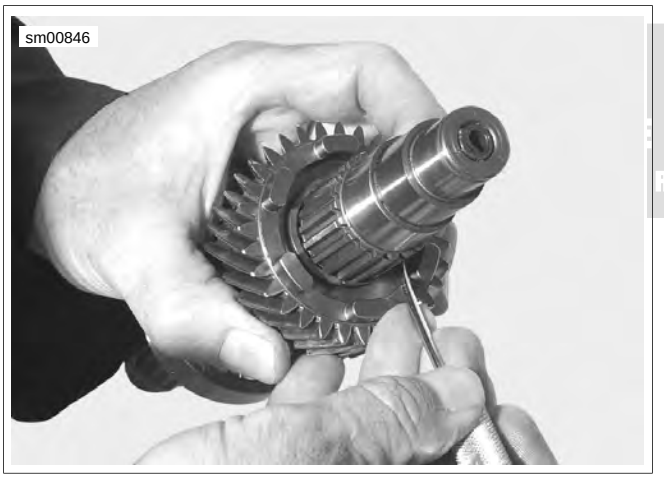


Figure 6-145. 4th Gear and Keepers

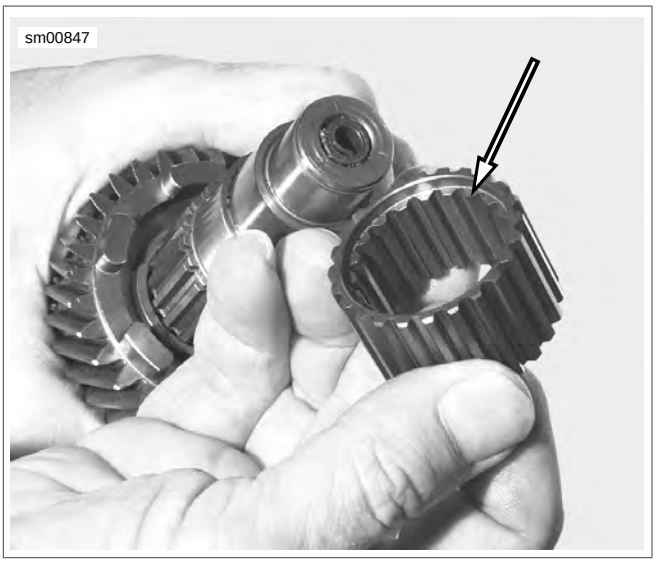


Figure 6-146. Splined Slider

2. See Figure 6-146. Insert splined slider with stepped side toward 4th gear.

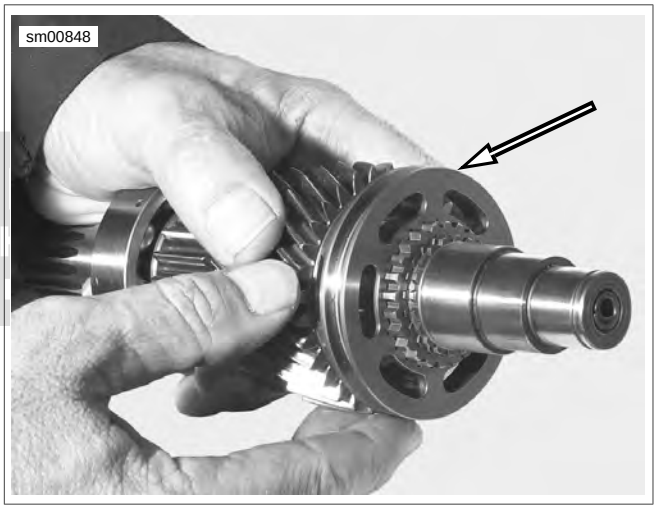


Figure 6-147. Shift Fork Slider

3. See Figure 6-147. Install shift fork slider.

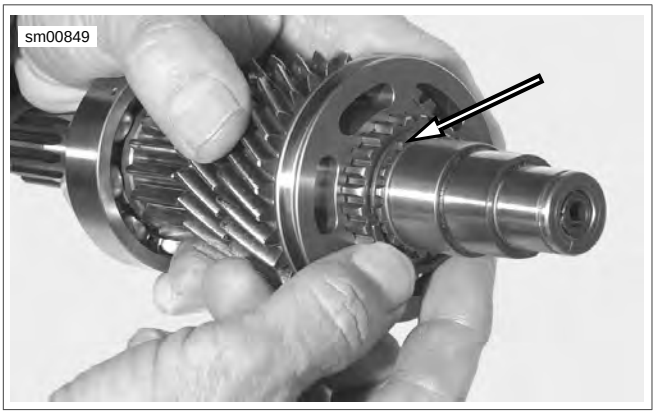


Figure 6-148. Half Moon Keepers

4. See Figure 6-148. Install half moon keepers.

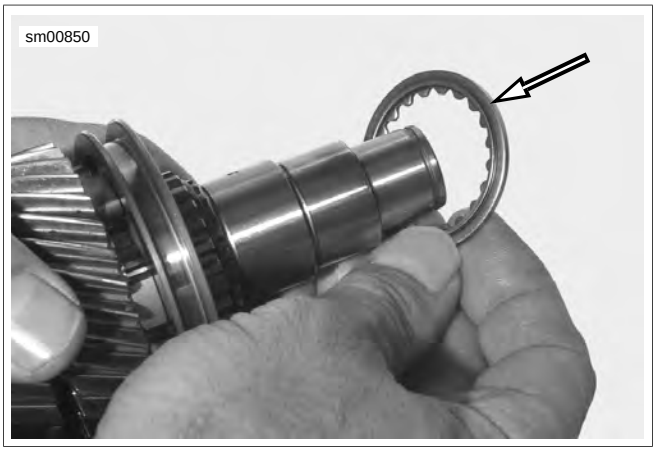


Figure 6-149. Splined Thrust Washer

5. See Figure 6-149. Install splined thrust washer, stepped side toward gears.

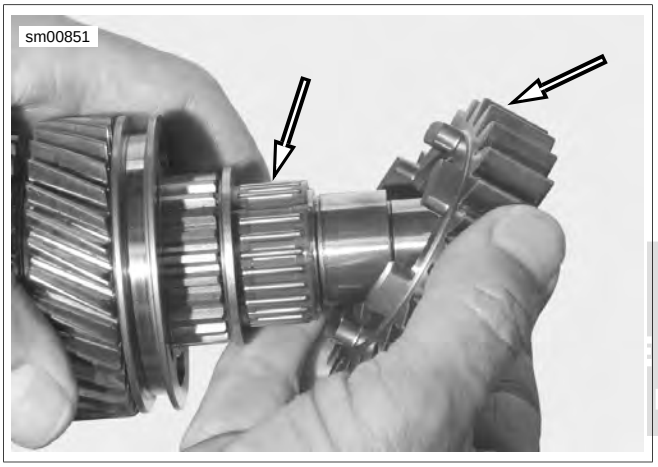


Figure 6-150. Bearing and 5th Gear

6. See Figure 6-150. Install lubricated **new** split cage bearing behind splined thrust washer. Install 5th gear over split cage bearing.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft, regardless of its condition.

7. See Figure 6-150. Install **new** 2nd gear. Use a pressing ring to clear the shaft. Press gear on shaft until it bottoms on the gearset.

8. To complete input shaft assembly 2nd gear end, go to 6.8 INPUT SHAFT, Disassembly: 2nd Gear End.



Figure 6-151. 2nd Gear

DISASSEMBLY: 1ST GEAR END

Bearing Removal: 1st Gear End

See Figure 6-152. Remove 1st gear crankcase bearing.



Figure 6-152. 1st Gear Bearing Removal

ASSEMBLY: 1ST GEAR END

Bearing Installation: 1st Gear End

See Figure 6-153. Install **new** bearing, with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.



Figure 6-153. 1st Gear Bearing Replacement

DRIVE BELT 6.9

REPLACEMENT

FASTENER	TORQUE VALUE	
Locking bolts	88-102 Nm	65-75 ft-lbs
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**
Rear axle nut	190-203 Nm	140-150 ft-lbs
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. See Figure 6-155. Remove drive sprocket cover (6) fasteners (9) and washers (8). Grommets (7) and bushings (10) should stay with cover (6).
3. Loosen locking bolts (5) holding drive sprocket (3) to drive sprocket flange (4).
4. Block motorcycle underneath frame so weight of motorcycle is off rear wheel.
5. Remove fastener holding lower debris deflector to rear fork. Pull debris deflector rearward off of rubber grommet. See 2.35 BELT GUARD AND DEBRIS DEFLECTOR.
6. Loosen left lower shock bolt until belt guard is free and pull belt guard rearward off of rubber grommets.
7. Remove axle retaining ring and loosen axle nut and adjuster from right side of axle.
8. Relieve belt tension by rotating axle adjusters.

NOTE

Wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

9. Remove shock bolt and swing shock up and out of the way.
10. See Figure 6-155. Slip drive belt (2) off wheel sprocket (1) and drive sprocket (3).
11. Inspect both drive and wheel sprocket for indicators of wear, misalignment, and damage. See 1.10 DRIVE BELT AND SPROCKETS.

NOTES

- *When a drive belt is replaced for any reason other than stone damage, it is recommended that the drive and wheel sprockets also be replaced to increase the longevity of the **new** drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.*
- *Do not remove the drive sprocket flange nut.*

12. Remove locking bolts (5) from drive sprocket and discard bolts.
13. Rotate drive sprocket (3) to fit spoke pattern of flange (4) and remove sprocket.

NOTE

*Verify threads are free of old thread lock material before installing **new** locking bolts.*

14. Install drive sprocket by matching spokes of drive sprocket to open spaces of drive sprocket flange and rotate drive sprocket to align sprocket bolt holes behind mounting flange bolt holes.
15. Install and tighten three **new** locking bolts (5) to 88-102 Nm (65-75 ft-lbs).

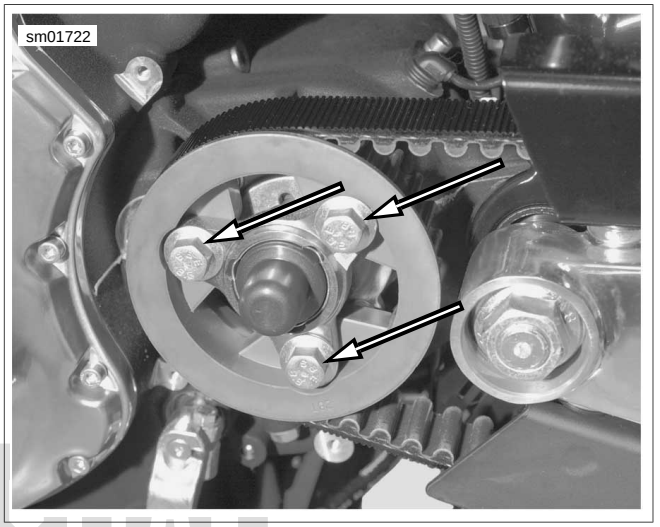
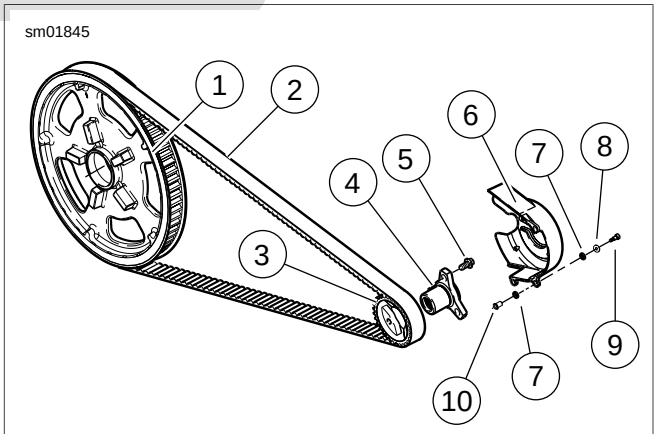


Figure 6-154. Drive Sprocket Retaining Bolts



1. **Wheel sprocket**
2. **Drive belt**
3. **Drive sprocket**
4. **Drive sprocket flange**
5. **Locking bolts**
6. **Drive sprocket cover**
7. **Grommet (2)**
8. **Washer**
9. **Fastener**
10. **Bushing**

Figure 6-155. Sprocket and Belt Components (typical)

16. Remove the rear wheel and replace the wheel sprocket if necessary. See 2.26 REAR WHEEL.
17. See Figure 6-155. Fit replacement belt (2) around drive sprocket (3) and over wheel sprocket (1).
18. Rotate axle adjusters to seat drive belt on sprockets. Tighten axle nut to hold in place.
19. Slide belt guard slots onto rubber grommet.
20. Thread shock mount bolt into belt guard and tighten shock mount bolt. See 2.36 REAR SHOCK ABSORBERS.
21. Slide debris deflector slots onto corresponding rubber grommet. Install debris deflector fastener and tighten to 6-10 Nm (53-88 **in-lbs**).
22. Measure belt guard to drive sprocket clearance.
23. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
24. Verify axle alignment and adjust belt deflection. See 1.10 DRIVE BELT AND SPROCKETS.

WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling and can cause loss of control, which could result in death or serious injury. (00285b)

25. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
26. Install snap ring.
27. Install belt drive sprocket cover and tighten cover fasteners to 6-10 Nm (53-88 **in-lbs**).
28. Install main fuse and right side cover and tighten fasteners to 4.1-6.8 Nm (36.3-60.2 **in-lbs**).

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

DRIVE SPROCKET FLANGE 6.10

REPLACEMENT

PART NUMBER	TOOL NAME
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL
HD-45332	FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER
SNAP-ON CJ2001	METRIC BOLT GRIP PULLER SET
SNAP-ON DC2001	METRIC BOLT GRIP PULLER SET

FASTENER	TORQUE VALUE	
Drive sprocket flange nut	160 Nm	118 ft-lbs
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs
Locking bolts	88-102 Nm	65-75 ft-lbs

NOTE

The drive sprocket flange can be replaced on the transmission output shaft with the shaft removed from the engine cases. See 6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End under 6.7 OUTPUT SHAFT. The following procedure replaces the drive sprocket flange without removing the engine from the motorcycle.

1. Remove the fasteners and the drive sprocket cover. See 6.9 DRIVE BELT.
2. With rear wheel on ground, loosen retaining bolts holding drive sprocket to drive sprocket flange.
3. Support motorcycle with rear wheel off the ground. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
4. Remove drive sprocket retaining bolts from drive sprocket. Discard bolts.
5. Rotate sprocket to fit spoke pattern of mounting flange and remove sprocket.
6. See Figure 6-157. Remove the plastic cap (5).
7. Use awl to remove the flange nut lock ring (4) from the drive sprocket flange (1).
8. Fit the lock pins of the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) to the sprocket mounting holes in the drive sprocket flange (1).

NOTE

Do not use an impact wrench to remove or install the drive sprocket flange nut. Damage to the threads on the output shaft of the transmission can result.

9. Fit a thin-wall 30 mm socket onto the flange nut.
10. See Figure 6-156. Holding the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) with a 1/2 in. drive breaker bar in the square hole, loosen and remove the flange nut.

NOTE

Drive sprocket flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.

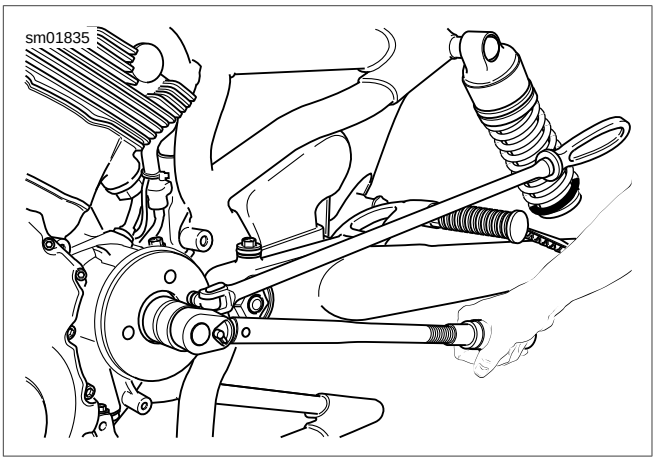
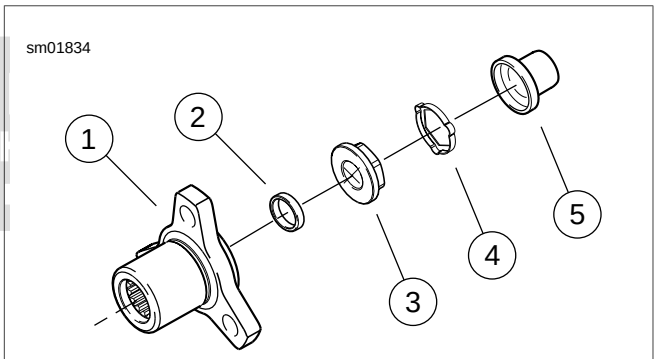


Figure 6-156. Loosen Output Shaft Nut with Final Drive Sprocket Flange Locking Tool (HD-45331-A) (typical)



1. **Drive sprocket flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

Figure 6-157. Drive Sprocket Flange Components

11. Obtain three 3/8 x 5 in. bolts with washers and nuts. Install a METRIC BOLT GRIP PULLER SET (Part No. Snap-on DC2001) onto the flange and shaft. Remove the drive sprocket flange.

NOTE

The drive sprocket flange seal is held in place with a retainer. Replace the seal any time the drive sprocket flange is removed.

12. Remove the fasteners and the seal retainer.
13. Remove and discard the flange seal and O-ring.
14. Install a **new** O-ring and **new** flange seal in the seal retainer. Lubricate the flange seal with GENUINE HARLEY-DAVIDSON H-D 360 MOTORCYCLE OIL 20W50.

15. Slide the seal retainer on the drive sprocket flange.
16. Slide the splined drive sprocket flange onto the output shaft.
17. Install the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A). Hold the tool with a 1/2 in. drive extension.

NOTES

- *Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.*
- *Do not use an impact wrench to remove or install the drive sprocket flange nut. It can damage the threads on the output shaft of the transmission.*

18. Use the old flange nut to pull the drive sprocket flange onto the shaft.
19. Remove and discard the old flange nut.
20. Install a **new** O-ring behind the flange nut and install the **new** flange nut.
21. Tighten the flange nut to 160 Nm (118 ft-lbs).
22. Install fasteners in seal retainer and tighten in a alternating pattern to 23 Nm (17 ft-lbs).
23. See Figure 6-157. Position locking ring (4) over the flange nut (3).
24. Install METRIC BOLT GRIP PULLER SET (Part No. Snap-on CJ2001) onto the flange and shaft using three 3/8 x 5 in. bolts with washers and nuts.

NOTES

- *Never use a hammer to hit on the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332). Damage to output shaft bearing could result.*
- *Do not use an impact wrench to remove or install the drive sprocket flange nut. It can damage the threads on the output shaft of the transmission.*

25. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332) to crimp lock ring in position.
26. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
27. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
28. Install the belt and the drive sprocket cover. See 6.9 DRIVE BELT.



Figure 6-158. Seal Retainer and Output Flange

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NOTES

FASTENER TORQUE VALUES 7.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Alternator cover fastener	9.7 Nm	86 **in-lbs**	7.19 ALTERNATOR, Installation
Alternator cover harness clip fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Assembly
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs	7.19 ALTERNATOR, Installation
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs	7.19 ALTERNATOR, Installation
Battery terminal bolt	6.8-7.9 Nm	60-70 **in-lbs**	7.24 OIL PRESSURE SWITCH, Installation
Cooling fan fasteners	5-7 Nm	44-62 **in-lbs**	7.27 COOLING FANS, Installation
Crank position sensor fastener	8.2-10.7 Nm	73-95 **in-lbs**	7.18 CRANK POSITION SENSOR (CKP), Installation
cross member fasteners	20-26 Nm	14.7-19.2 ft-lbs	7.27 COOLING FANS, Installation
Derby cover fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Installation
Fender light assembly: VRSCDX (rear)	1.5-2.0 Nm.	13.2-17.7 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	7.29 RIGHT HANDLEBAR SWITCH, Installation/T25 TORX
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	7.30 LEFT HANDLEBAR SWITCH, Installation/T27 TORX
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	7.29 RIGHT HANDLEBAR SWITCH, Installation/T25 TORX
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	7.30 LEFT HANDLEBAR SWITCH, Installation/T25 TORX
Headlamp bracket fastener	11-18 Nm	8-13 ft-lbs	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Hex-nut	6-10 Nm	53-88 **in-lbs**	7.10 STARTER, Installation
Hex-nuts	6-10 Nm	53-88 **in-lbs**	7.11 STARTER SOLENOID, Installation
Horn assembly acorn nut	9-15 Nm	80-132 **in-lbs**	7.26 HORN, Replacement
Horn flange nut	6-8 Nm	53-70 **in-lbs**	7.26 HORN, Replacement
Ignition/light switch fasteners	4-7 Nm	35-62 **in-lbs**	7.12 IGNITION/HEADLAMP KEY SWITCH, Replacement
Instrument cluster housing screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Instrument cluster screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Instrument cluster to housing fasteners	1.3-1.9 Nm	12-16 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
Instrument housing hinge fastener	2.2-2.8 Nm	20-24 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
license plate lamp fasteners (VRSCDX)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
Mirror adjustment fastener	11-13 Nm	97-115 **in-lbs**	7.17 TURN SIGNALS: VRSCF, Turn Signal Replacement
Neutral switch	12.8-16.5 Nm	113-146 **in-lbs**	7.23 NEUTRAL SWITCH, Installation
Oil pressure switch	10.8-13.6 Nm	96-120 **in-lbs**	7.24 OIL PRESSURE SWITCH, Installation
Radiator cover fasteners	4.1-6.8 Nm	36-60 **in-lbs**	7.27 COOLING FANS, Installation
Radiator front cover fasteners	4.1-6.8 Nm	36.3-60.1 **in-lbs**	7.7 VOLTAGE REGULATOR, Installation

FASTENER	TORQUE VALUE		NOTES
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.19 ALTERNATOR, Installation
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.27 COOLING FANS, Installation
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.27 COOLING FANS, Installation
Side cover fastener	4.1-6.8 Nm	36-60 **in-lbs**	7.6 MAIN FUSE, Replacement
Starter mounting bolts	9.8 Nm	86.7 **in-lbs**	7.10 STARTER, Installation
Stator mounting fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Assembly
Stoplamp switch	8.5-11.5 Nm	75.2-101.7 **in-lbs**	7.25 REAR STOPLIGHT SWITCH, Installation
Tail lamp screws	1.5-2 Nm	13-18 **in-lbs**	7.15 TAIL LAMP: VRSCF, Installation
Tail lamp screws: VRSCDX	1.5-2.0 Nm	13.3-17.7 **in-lbs**	7.14 TAIL LAMP: VRSCDX, Installation
Top housing fastener	2.2-2.8 Nm	20-24 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
Turn signal fastener	7.3-8.5 Nm	64.6-75.2 **in-lbs**	7.17 TURN SIGNALS: VRSCF, Turn Signal Replacement
Turn signal fasteners: VRSCDX (rear)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
upper cooling fan fastener	19-27 Nm	14.0-19.9 ft-lbs	7.27 COOLING FANS, Installation
Voltage regulator fastener	6-10 Nm	53-88 **in-lbs**	7.7 VOLTAGE REGULATOR, Installation
VSS mounting fastener	8.2-10.7 Nm	73-95 **in-lbs**	7.22 VEHICLE SPEED SENSOR (VSS), Installation

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

SPECIFICATIONS: ELECTRICAL 7.2

GENERAL

Table 7-1. Electrical

ITEM	SPECIFICATION	
Timing setting	Not adjustable	
Battery	12 volt, 19 amp-hr, 315 CCA	
Charging system	Three-Phase, 38-amp system (439W @ 13V, 2000 rpm, 489W max power @ 13V)	
Spark plug type	10R12A	
Spark plug gap	0.035 in.	0.89 mm
Spark plug torque	17 ft-lbs	23 Nm

Table 7-2. Fuse Specifications

FUSE	RATING (AMPERES)
Main fuse	40
ABS fuse (if equipped)	30
Battery fuse (instrument console/fan relay)	15
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
ECM fuse	15
Security fuse	15
Fuel pump fuse	15

Table 7-3. Charging System Specifications

CHARGING SYSTEM	DATA
Alternator AC voltage output, open circuit (at stator connector)	19 VAC ± 10% per 1000 rpm 22.5 VAC ± 10% @ idle (1200 rpm)
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output (with fully charged battery)	14.5 ± 0.25 volts @ 1200 rpm 20 °C ± 5 °C (68 °F ± 9 °F)
Regulator current	22A min. @ 1200 RPM 36A min. @ 3500 RPM

Table 7-4. Starter Performance

STARTER	
Free speed	9200 RPM (min)
Free current	32 Amp
Cranking current	180 Amp

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

ELECTRONIC CONTROL MODULE (ECM) 7.3

GENERAL

The electronic control module (ECM) is mounted under the passenger pillion. See the electrical diagnostic manual for information on the function and testing of the electronic control module.

NOTES

- *The ECM cannot be repaired. Replace the unit if it fails.*
- *If replacing the ECM, it must be calibrated using DIGITAL TECHNICIAN II.*

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

NOTES

- *On VRSCF models, remove security siren (if equipped) from top of ECM. Security siren is secured to electrical caddy with clips.*
- *On domestic VRSCDX models only, remove stop/turn/tail module (STT) from top of ECM. STT is secured to ECM with two-sided tape.*

1. Disable alarm system (if equipped).
2. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
3. Open seat and remove passenger pillion. See 2.38 SEAT.
4. See Figure 7-1 or Figure 7-2. Lift upward on electrical caddy and press latch (2) on ECM connector (1) [78B] and disconnect from ECM.
5. Push downward on ECM and remove ECM (4) from bottom of electrical caddy.

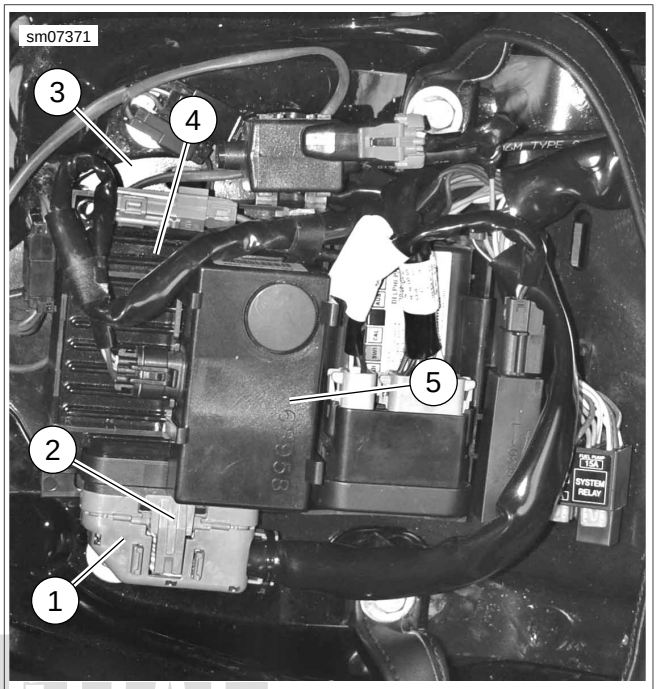
INSTALLATION

1. See Figure 7-1 or Figure 7-2. Install ECM (4) into bottom of electrical caddy (3) and press firmly until ECM is fully seated.
2. Install electrical caddy to rear fender, locking all tabs into place.
3. Insert ECM connector (1) [78B] into ECM latch locks.
4. On VRSCF models, install security siren (if equipped) on ECM.
5. On domestic VRSCDX models only, secure STT module to ECM with two-sided tape.
6. Install main fuse and right side cover See 7.6 MAIN FUSE.

NOTE

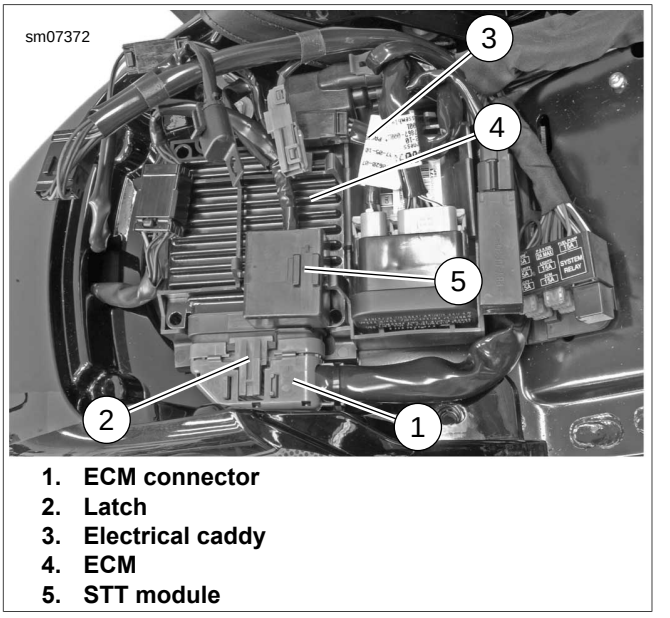
After installing a replacement ECM, perform ECM reprogramming and password learn procedures.

7. Perform password learn procedure. See 7.34 TSM/HFSM: PASSWORD LEARN.
8. Install passenger pillion and close seat. See 2.38 SEAT.



1. **ECM connector**
2. **Latch**
3. **Electrical caddy**
4. **ECM**
5. **Security siren (if equipped)**

Figure 7-1. ECM: VRSCF



1. **ECM connector**
2. **Latch**
3. **Electrical caddy**
4. **ECM**
5. **STT module**

Figure 7-2. ECM: VRSCDX

TURN SIGNAL AND SECURITY MODULE (TSM/TSSM/HFSM) 7.4

GENERAL

The Turn Signal Security Module (TSSM) is located beneath the passenger seat, mounted in an electrical caddy on the rear fender.

REMOVAL

1. Disarm security system (if equipped).
2. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.
3. Open seat and remove passenger pillion. See 2.38 SEAT.
4. See Figure 7-3. Disconnect wiring harness connectors [30] and HFSM antenna connector [208] (if equipped) from module.
5. Lift up module and slide it out of mounting bracket.

TSM/HFSM/TSSM CONFIGURATION

- After replacing TSSM, check if a password learning process is necessary. For more information, refer to Table 7-5. For information on the password learning procedure, see 7.34 TSM/HFSM: PASSWORD LEARN.
- After replacement of TSM/TSSM/HFSM, always perform key fob assignment and personal code entry. See 7.33 H-DSSS ACTUATION.

Table 7-5. Password Learning Needed?

Device Replaced	Is Password Learn Necessary?
ECM	Yes
TSM	No*
TSM/HFSM	Yes
*If a TSM has been replaced by an HFSM, or an HFSM has been replaced by a TSM, password learn **is** necessary.	

INSTALLATION

1. Slide **new** module into mounting bracket. Make sure module slides all the way forward in the bracket.
2. Connect wiring harness connectors [30] and HFSM antenna connector [208] (if equipped) to module.

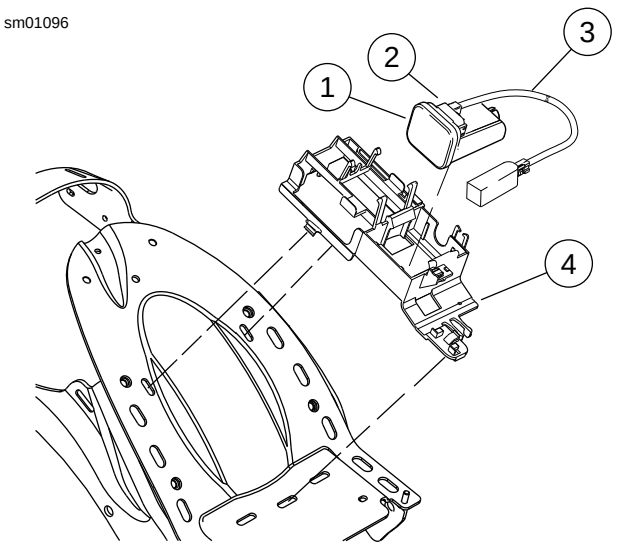
NOTE

When installing pillion, Make sure module wiring harness is not pinched under pillion frame.

3. Install passenger pillion. See 2.38 SEAT.
4. Replace main fuse. See 7.6 MAIN FUSE.
5. Perform password learn procedure. See 7.34 TSM/HFSM: PASSWORD LEARN.
6. Install right side cover.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)



1. **TSM/TSSM/HFSM module**
2. **Wiring harness connector location**
3. **HFSM antenna (if equipped)**
4. **Electrical caddy**

Figure 7-3. TSM/TSSM/HFSM Module

RELAY AND FUSE BLOCK 7.5

GENERAL

The relay/fuse block assembly consists of two relay/fuse blocks and is located under the right side cover and the rear seat. All relays and fuses (with the exception of the main battery fuse - see 7.6 MAIN FUSE) are contained in these two relay/fuse blocks.

NOTE

If motorcycle is ABS equipped, the fuse will be located between the SPARE and IGNITION fuses in the fuse block that is located behind the right side cover.

RELAY/FUSE BLOCK REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Open seat.
3. See Figure 7-4. Gently lift up each relay/fuse block cover release tab and slide each relay/fuse block assembly out of the cover.

FUSE REPLACEMENT

1. See Figure 7-6. Grasp the suspect fuse and gently pull straight out of the fuse socket.
2. Inspect the fuse element. Replace the fuse if the element is burned or broken.
3. Line up the pins of the fuse with the socket holes in the relay/fuse block. Push gently down on the fuse body until it bottoms out in the socket.

NOTES

- *Two spare fuses are located in the left relay/fuse block.*
- *If ABS equipped, ABS fuse will be located between spare and ignition fuses in front fuse block.*

NOTICE

Always use replacement fuses that are of the correct type and amperage rating. Use of incorrect fuses can result in damage to electrical systems. (00222a)

NOTE

Use only automotive type ATO fuses as replacements.

RELAY REPLACEMENT

1. See Figure 7-6. If a relay is diagnosed as defective, grasp the body of the relay and with a gentle rocking motion, pull straight out of the socket.
2. Line up the pins of the **new** relay with the socket holes in the relay/fuse block. Push gently down on the relay body until it bottoms out in the socket.

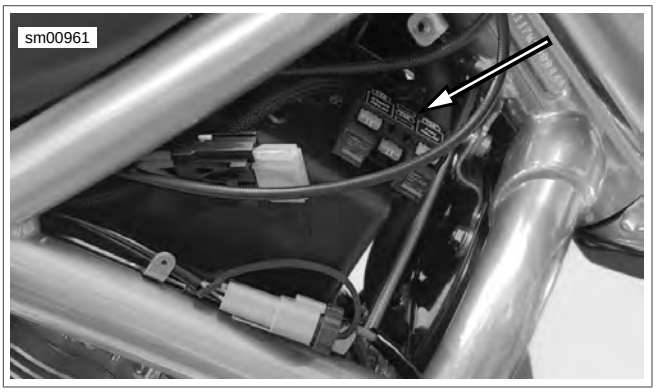


Figure 7-4. Front Relay/Fuses



Figure 7-5. Rear Relay/Fuses

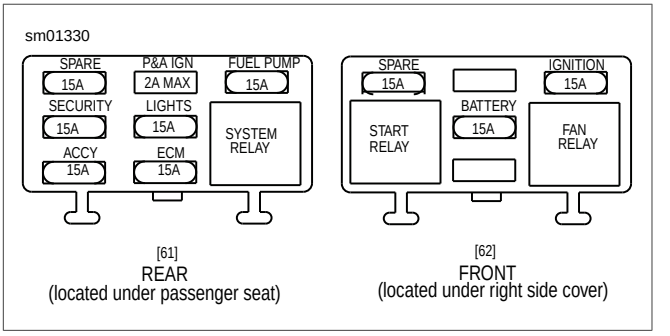


Figure 7-6. Relay/Fuse Blocks (NON-ABS shown)

RELAY/FUSE BLOCK INSTALLATION

1. See Figure 7-4. Slide each relay/fuse block assembly back into relay/fuse block cover. Push relay/fuse block assembly into the cover until cover release tab locks into place.
2. Replace main fuse and right side cover.
3. Test the vehicle system that is controlled by the relay or fuse that was replaced.

MAIN FUSE 7.6

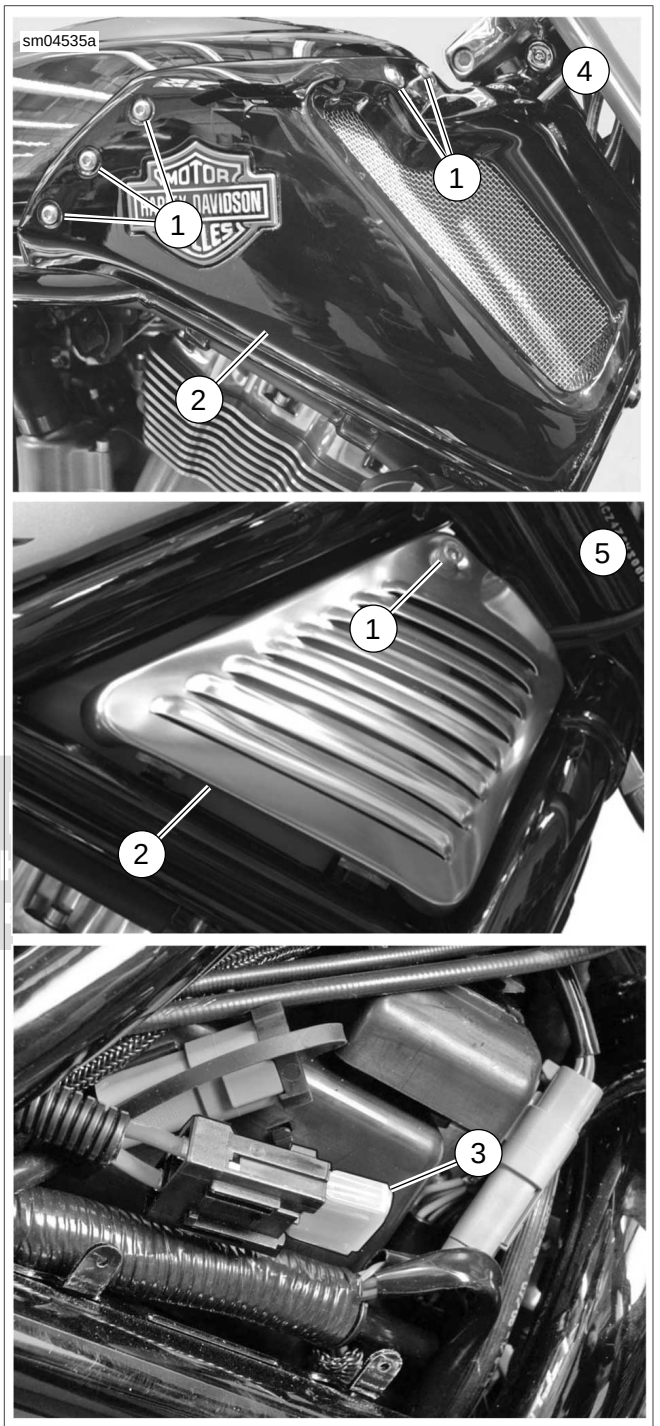
GENERAL

There is a main battery fuse to protect the motorcycle wiring. This 40-amp main fuse provides main battery power to the motorcycle. It is located in a rubber-coated fuse holder behind the motorcycle's right front side cover.

REPLACEMENT

FASTENER	TORQUE VALUE	
Side cover fastener	4.1-6.8 Nm	36-60 **in-lbs**

1. See Figure 7-7. Remove the fastener (1) securing the side cover (2). Carefully lift the side cover off the mounting tabs and set it aside.
2. Grasp the fuse holder in one hand, the plastic body of the main fuse (3) in the other, and pull the main fuse straight out of the fuse holder.
3. Insert the prongs of the **new** main fuse in the fuse holder slots. Push the main fuse firmly down into the fuse holder.
4. Replace the side cover and install the fastener. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).



1. **Fastener**
2. **Side cover**
3. **Main fuse (40 amp)**
4. **VRSCF models**
5. **VRSCDX models**

Figure 7-7. Main Fuse

VOLTAGE REGULATOR 7.7

GENERAL

The voltage regulator is mounted on the lower front radiator cover.

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails.

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove left and right radiator trim covers. See 1.16 RADIATOR SIDE COVERS.
3. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover. See 5.10 RADIATOR AND OIL COOLER.

NOTE

Before removing voltage regulator wires, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

4. See Figure 7-8. Release locks on wiring connectors [47] and [77] and remove connectors from back of regulator.

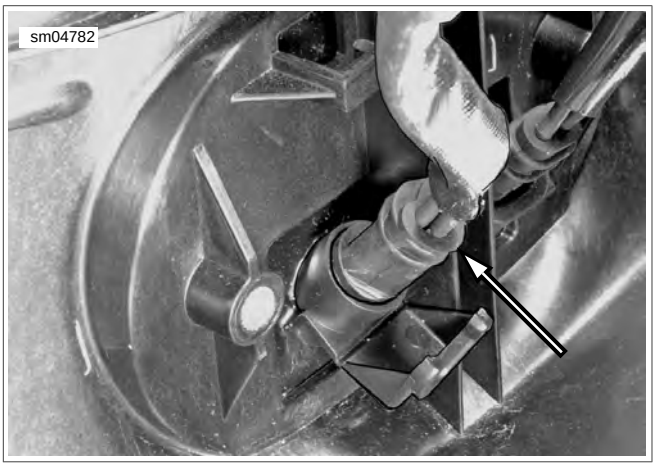


Figure 7-8. Voltage Regulator Connector

5. Remove fasteners from regulator mounting points and remove regulator from front cover.

INSTALLATION

FASTENER	TORQUE VALUE	
Voltage regulator fastener	6-10 Nm	53-88 **in-lbs**
Radiator front cover fasteners	4.1-6.8 Nm	36.3-60.1 **in-lbs**

1. Attach **new** voltage regulator to front cover with two mounting fasteners. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Insert both voltage regulator connections [47] and [77] and lock into place with lock tabs.
3. Install any cable straps that may have been removed.
4. Install radiator front cover and front cover fasteners. Tighten fasteners to 4.1-6.8 Nm (36.3-60.1 **in-lbs**). See 5.10 RADIATOR AND OIL COOLER.
5. Attach radiator side covers. See 1.16 RADIATOR SIDE COVERS.
6. Replace main fuse. See 7.6 MAIN FUSE.
7. Check voltage regulator for proper output. See the electrical diagnostics manual.

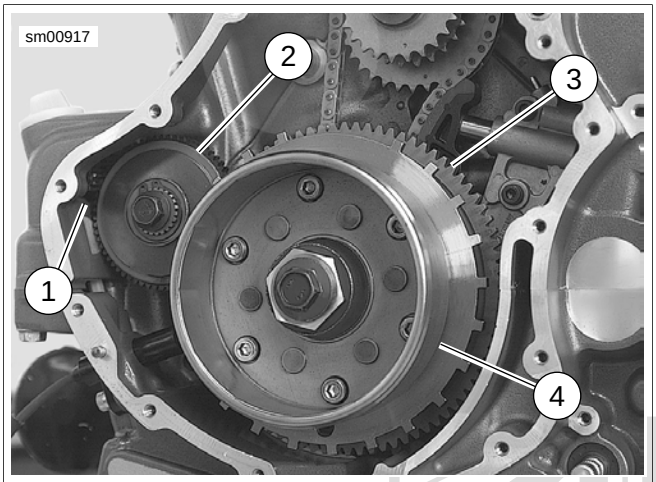
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STARTER SYSTEM 7.8

GENERAL

The starter system is made up of the starter relay, starter solenoid, and starter motor. The starter drive gear engages a geared limiter assembly which engages a starter ring gear whose hub rotates inside a ball clutch on the rotor assembly.

The rotation of the starter is transferred to the crankshaft of the engine through the ball clutch. The starter motor torque is multiplied through the gear reduction of the starter drive gear to the limiter assembly gear and to the starter ring gear. The three gears remain in constant engagement.



1. **Starter drive gear**
2. **Limiter assembly**
3. **Starter ring gear**
4. **Rotor**

Figure 7-9. Starter Drive (Left side engine cover/stator removed)

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagrams in back of book.

Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

Starter

The starter is not repairable. Replace the unit if it fails.

Starter Solenoid

The starter solenoid is not repairable. Replace the unit if it fails.

OPERATION

When the starter switch is pushed, the starter relay is activated which activates the starter solenoid allowing current to flow to the starter motor.

The starter drive gear transfers rotation to the limiter assembly and the limiter assembly gear transfers rotation to the starter ring gear. The starter ring gear drives the alternator rotor on the end of the crankshaft.

When the engine starts, a ball clutch on the back side of the rotor disengages allowing the starter ring gear and the rotor to rotate independently of each other.

NOTE

For troubleshooting and diagnostic information, see the electrical diagnostics manual.

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STARTER RELAY 7.9

REMOVAL

NOTES

- *Before removing the relay, perform diagnostics listed in the electrical diagnostic manual.*
- *The starter relay is located beneath the right-side cover in the fuse block.*

1. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.
2. See Figure 7-10. Remove starter relay from fuse block.

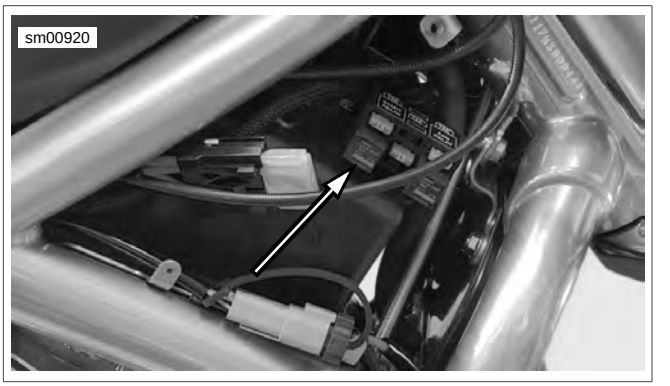


Figure 7-10. Starter Relay

INSTALLATION

1. Install relay in fuse block.
2. Slide cover over fuse blocks until latches fully engage tabs on blocks.
3. Slide fuse blocks onto frame mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover.
4. Install main fuse and right side cover.

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STARTER 7.10

REMOVAL

NOTE

Before removing the starter, perform diagnostics listed in the electrical diagnostics manual.

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove the air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect the negative battery cable. See 1.24 BATTERY MAINTENANCE.
4. Remove exhaust system to provide clearance for starter removal. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF.
5. Pull back solenoid cable protective boot and loosen and remove hex-nut. Remove solenoid cable terminal ring (2).
6. Remove both starter mounting bolts and washers (1).
7. Remove starter from right side of motorcycle.

INSTALLATION

FASTENER	TORQUE VALUE	
Starter mounting bolts	9.8 Nm	86.7 **in-lbs**
Hex-nut	6-10 Nm	53-88 **in-lbs**

1. Lubricate the starter O-ring with SPECIAL PURPOSE GREASE.
2. Install starter gear shaft into engine housing.

NOTE

Be sure starter gear shaft engages the teeth of the limiter assembly in the engine housing.

3. See Figure 7-11. Install the two starter mounting bolts and washers (1). Alternately tighten the bolts to 9.8 Nm (86.7 **in-lbs**).
4. Slide solenoid cable terminal ring (2) over starter post. Thread on and tighten hex-nut to 6-10 Nm (53-88 **in-lbs**).
5. Slide protective boot securely over terminal.

NOTICE

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

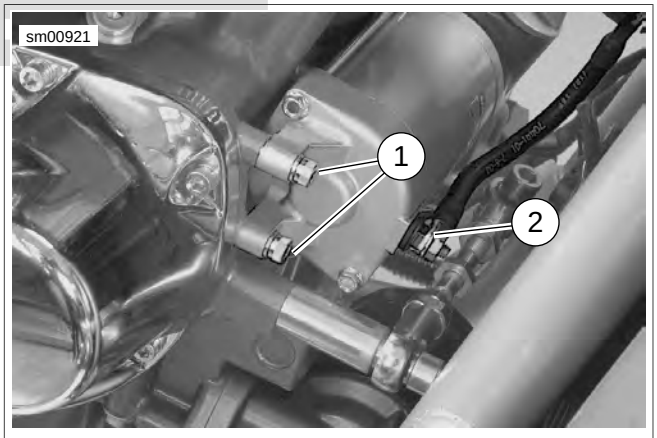
NOTICE

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

⚠WARNING

Be sure rubber boot covers starter solenoid terminal connected to positive (+) battery cable. An uncovered terminal can short and cause sparks, which could result in a battery explosion and death or serious injury. (00463c)

6. Install exhaust system. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF.
7. Connect negative battery cable. See 1.24 BATTERY MAINTENANCE.
8. Install air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
9. Install main fuse and the right side cover. See 7.6 MAIN FUSE.



1. **Starter mounting bolts and washers**
2. **Solenoid cable terminal ring**

Figure 7-11. Starter (protective boot removed)

STARTER SOLENOID 7.11

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

NOTE

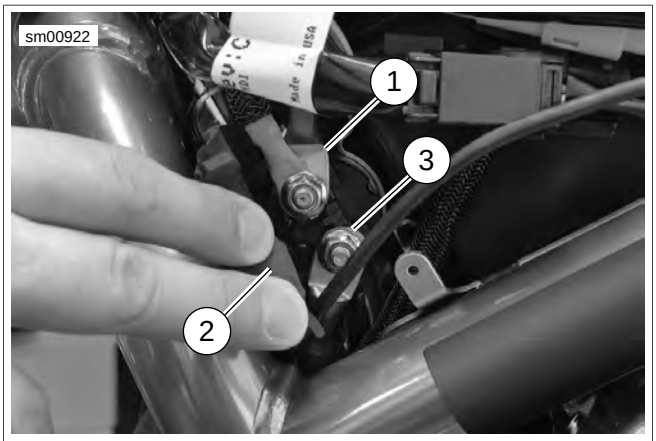
The radiator fans are thermostatically controlled and will run with the ignition switch in the OFF position. However, pulling the main fuse will disconnect power to the fans. To prevent damage to engine components, be sure the radiator has cooled before removing the main fuse.

1. Remove left and right side covers and remove main fuse. See 7.6 MAIN FUSE.
2. Open rider's seat.
3. Remove the air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect the negative battery cable from battery. See 1.24 BATTERY MAINTENANCE.
5. See Figure 7-12. Pull back starter cable hex-nut cover (2). Note cable locations and remove cable hex-nuts and cables.
6. Slide solenoid back and free from mounting tabs.
7. Disconnect starter solenoid harness connector [128] from main wiring harness and remove solenoid.



1. **Positive battery cable**
2. **Starter cable hex-nut cover**
3. **Starter cable**

Figure 7-12. Starter Solenoid

INSTALLATION

FASTENER	TORQUE VALUE	
Hex-nuts	6-10 Nm	53-88 **in-lbs**

1. See Figure 7-13. Connect starter solenoid harness connector [128] to main wiring harness.
2. Slide solenoid into position on mounting tabs on back of battery tray.
3. Install cables in locations noted when removed.
4. Thread on and tighten the hex-nuts to 6-10 Nm (53-88 **in-lbs**).
5. Install starter cable hex-nut cover onto solenoid.

NOTICE

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

NOTICE

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

6. Connect negative battery cable to battery. See 1.24 BATTERY MAINTENANCE.
7. Install air box cover. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
8. Install the main fuse and both side covers. See 7.6 MAIN FUSE.
9. Close seat.



Figure 7-13. Solenoid Paired Black Wire and Green Wire Lead (typical)

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IGNITION/HEADLAMP KEY SWITCH 7.12

GENERAL

The ignition switch is non-repairable. If damaged, it must be replaced.

⚠WARNING

The automatic-on headlamp feature provides increased visibility of the rider to other motorists. Be sure headlamp is on at all times. Poor visibility of rider to other motorists can result in death or serious injury. (00030b)

REPLACEMENT

FASTENER	TORQUE VALUE	
Ignition/light switch fasteners	4-7 Nm	35-62 **in-lbs**

1. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.
2. See Figure 7-14. Remove ignition switch protective cover by pressing in location shown by arrows using thumb and index fingers. Simultaneously lift up at bottom of protective switch cover with index finger of opposite hand and pull cover away from base of switch.



Figure 7-14. Ignition Switch Cover

3. See Figure 7-15. Remove fasteners and remove ignition switch from frame.

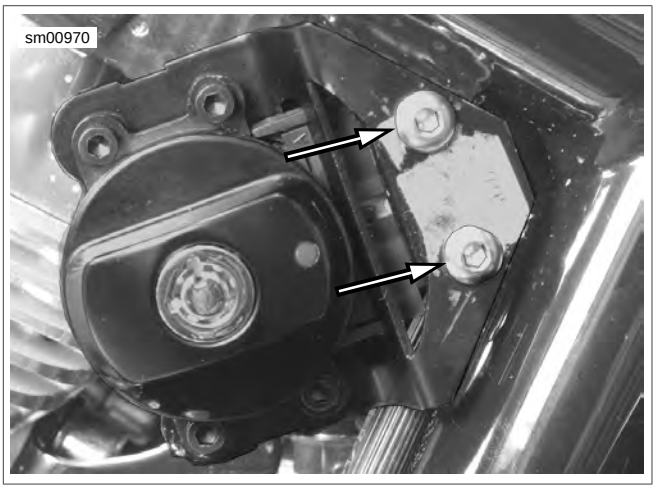


Figure 7-15. Ignition Switch Fasteners

4. See Figure 7-16. Carefully release latching tabs securing wiring harness connector [33] to back of ignition switch. Pull connector out of ignition/light switch socket.

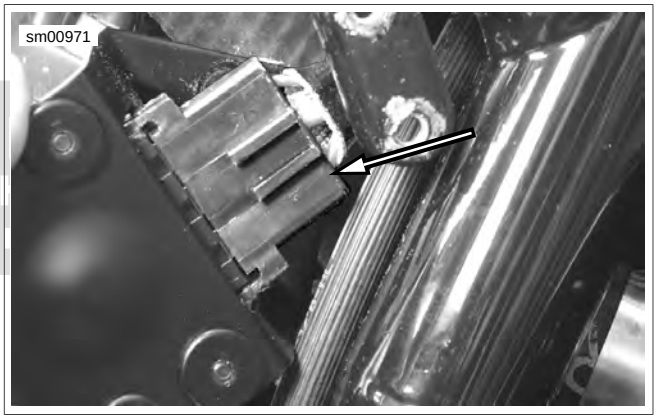


Figure 7-16. Ignition Switch Connector (switch turned over showing back side)

5. Insert wiring harness connector [33] into **new** ignition switch. Gently push connector into socket until it locks into place.
6. See Figure 7-15. Install ignition switch to frame. Secure with fasteners. Tighten fasteners to 4-7 Nm (35-62 **in-lbs**).
7. Replace right side cover and main fuse.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

8. Test all functions of ignition switch.

HEADLAMP 7.13

GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

NOTICE

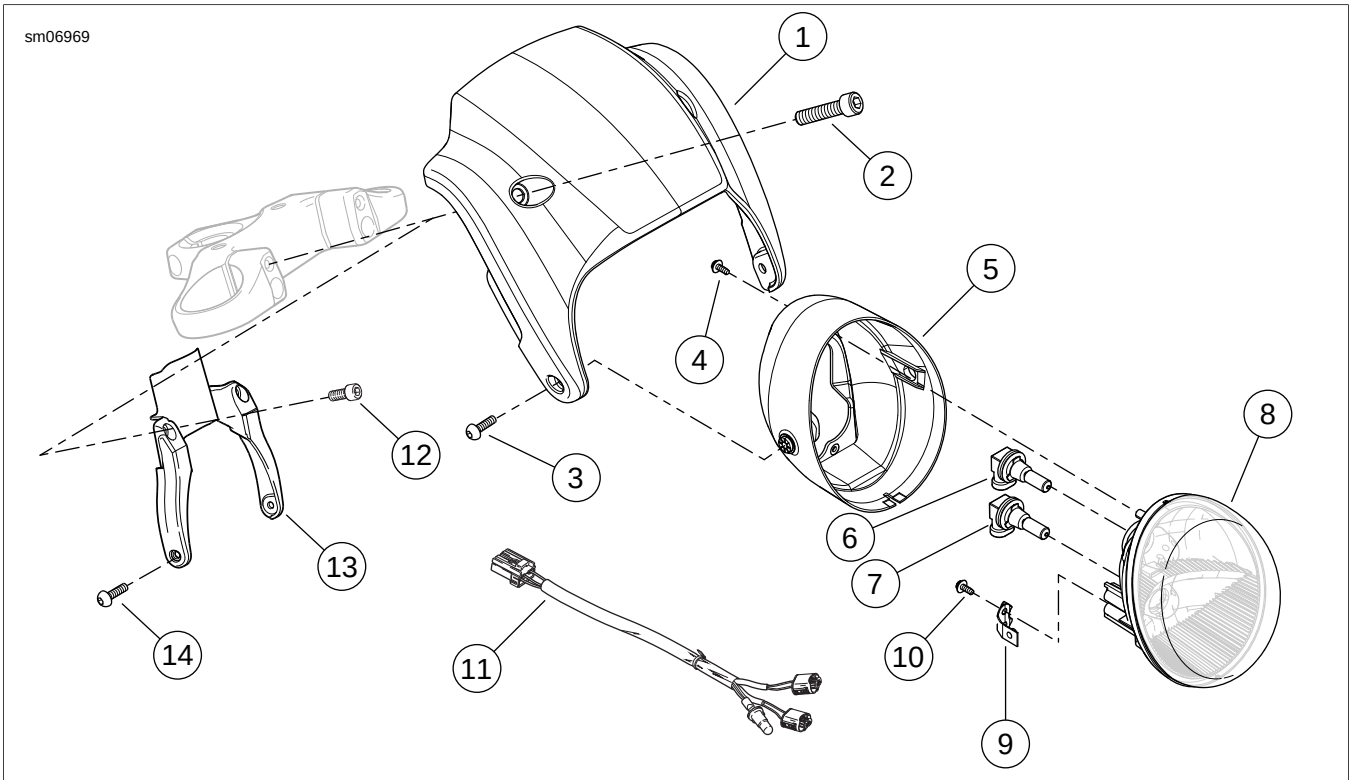
When replacement is required, use only the specified sealed beam unit or bulb, available from a Harley-Davidson dealer. An improper wattage sealed beam or bulb, can cause charging system problems. (00209a)

NOTICE

Never touch the quartz bulb. Fingerprints will etch the glass and decrease bulb life. Handle the bulb with paper or a clean, dry cloth. Failure to do so could result in bulb damage. (00210b)

⚠WARNING

Handle bulb carefully and wear eye protection. Bulb contains gas under pressure, which, if not handled carefully, could cause serious eye injury. (00062b)



1. **Headlamp mounting bracket (VRSCDX)**
2. **Bracket mounting fastener (2) (VRSCDX)**
3. **Fastener (2) (VRSCDX)**
4. **Fastener (2)**
5. **Headlamp bucket**
6. **Light bulb, low beam**
7. **Light bulb, high beam**
8. **Headlamp lens/reflector assembly**
9. **Reflector bracket (2)**
10. **Fastener (6)**
11. **Position lamp and harness (HDI only)**
12. **Bracket mounting fastener (2) (VRSCF)**
13. **Headlamp mounting bracket (VRSCF)**
14. **Fastener (2) (VRSCF)**

Figure 7-17. Headlamp

HEADLAMP BULB

Removal

NOTE

Headlamp disassembly not required for bulb replacement..

1. Squeeze the release latches on the connector and remove the connector from the headlamp bulb.
2. Rotate the headlamp bulb approximately 45 degrees counterclockwise (CCW) and pull straight out of the headlamp.

Installation

NOTE

The low beam headlamp bulb mounts in the top hole in the rear of the headlamp assembly. The high beam bulb mounts in the bottom hole.

1. See Figure 7-17. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp.
 a. Position the low beam bulb with its connector housing pointing to approximately 4 o'clock.
 b. Position the high beam bulb with its connector housing pointing to approximately 5 o'clock.
2. Rotate the bulb clockwise (CW) approximately 45 degrees, until it stops.

NOTE

Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

3. Install the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.

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TAIL LAMP: VRSCDX 7.14

REMOVAL

NOTE

The tail lamp uses non-replaceable LEDs. The entire lamp assembly must be replaced if failure occurs.

1. Remove turn signal light assembly. See 7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX.
2. See Figure 7-18. Remove screws securing tail lamp and remove tail lamp.

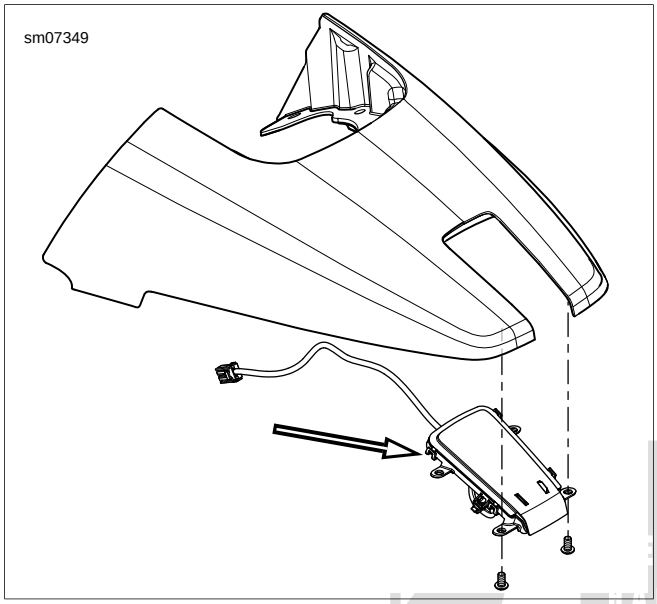


Figure 7-18. Tail Lamp

INSTALLATION

FASTENER	TORQUE VALUE	
Tail lamp screws: VRSCDX	1.5-2.0 Nm	13.3-17.7 **in-lbs**

1. See Figure 7-18. Install tail lamp with two screws. Tighten screws to 1.5-2.0 Nm (13.3-17.7 **in-lbs**)
2. Install turn signal light assembly. See 7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

3. Turn ignition ON and test for proper turn signal, tail lamp and brake lamp operation.

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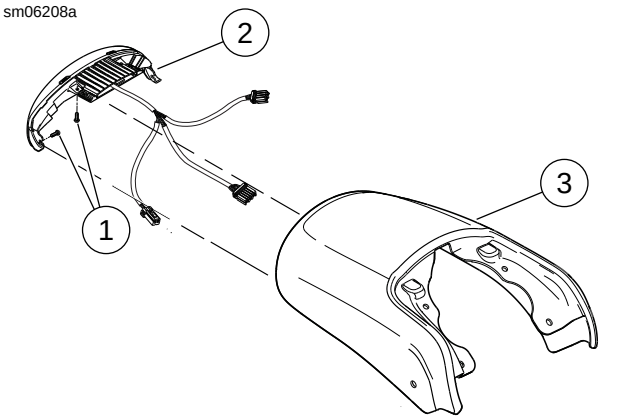
TAIL LAMP: VRSCF 7.15

REMOVAL

NOTES

- *The VRSCF uses non-replaceable LEDs. The entire lamp assembly must be replaced if failure occurs.*
- *Tail lamp cannot be removed with fender mounted to vehicle.*

1. Remove rear fender assembly from vehicle. See 2.39 REAR FENDER.
2. See Figure 7-19. Remove the four screws (1) securing the tail lamp (2) to the rear fender (3) and lift tail lamp assembly away from fender.



1. **Mounting screws (4)**
2. **Tail lamp/turn signal assembly**
3. **Rear fender**

Figure 7-19. Tail Lamp/Turn Signal Assembly: VRSCF

INSTALLATION

FASTENER	TORQUE VALUE	
Tail lamp screws	1.5-2 Nm	13-18 **in-lbs**

1. See Figure 7-19. Install tail lamp assembly onto rear fender and tighten screws to 1.5-2 Nm (13-18 **in-lbs**).
2. Install rear fender. See 2.39 REAR FENDER.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

3. Turn ignition ON and test for proper tail lamp, brake lamp and turn signal operation.

IGITAL
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TURN SIGNALS AND RUNNING LIGHTS: VRSCDX 7.16

BULB REPLACEMENT

1. Locate notch on edge of front or rear turn signal lens cap.
2. Insert coin in notch. Carefully twist coin until lens pops out of turn signal housing.
3. Replace bulb.
 a. Push bulb in and turn counterclockwise.
 b. Pull bulb from socket when tab on bulb clears opening on socket.
 c. Coat base of bulb with ELECTRICAL CONTACT LUBRICANT.
 d. Push **new** light bulb in and turn clockwise to lock in place.
4. Snap lens back into turn signal housing with the notch facing down.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

LAMP REPLACEMENT

FASTENER	TORQUE VALUE	
Turn signal fasteners: VRSCDX (rear)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**
Fender light assembly: VRSCDX (rear)	1.5-2.0 Nm.	13.2-17.7 **in-lbs**
license plate lamp fasteners (VRSCDX)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**

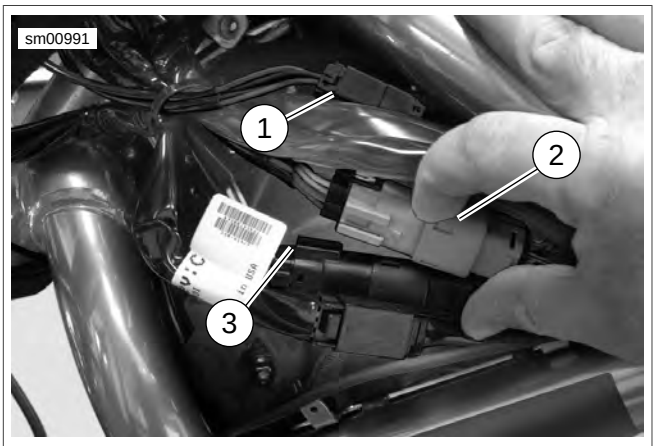
Front Turn Signals

1. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced if removed.

1. Remove left side cover.
2. See Figure 7-20. Separate front turn signal connector (1).
3. Note locations of turn signal wires in connector. Remove corresponding turn signal wire terminals from connector. See the electrical diagnostics manual for more information.
4. See Figure 7-22. Hold retainer and loosen ball stud clamp to remove turn signal.
5. Pull turn signal wire through routing hole in upper fork clamp and the handlebar cable clips.



1. **Front Turn Signal Connector [31]**
2. **Right handlebar controls connector [22]**
3. **Left handlebar controls connector [24]**

Figure 7-20. Front Turn Signal and Handlebar Control Switch Connectors (typical)



Figure 7-21. Front Turn Signal Connector [31] (typical)

6. Lay old turn signal assembly next to **new** one and cut **new** wires to length. Trim sheath back approximately 63.5 mm (2.5 in) from ends of wires.

7. Install **new** turn signal lamp housing and route wire harness through handlebar cable clips.
8. Continue routing signal wires through hole in upper fork clamp.
9. Crimp **new** pin terminals onto wires.
10. Insert terminals into turn signal connector and mate connector (1).
11. Install left side cover.
12. Install main fuse and right side cover.

Rear Turn Signals

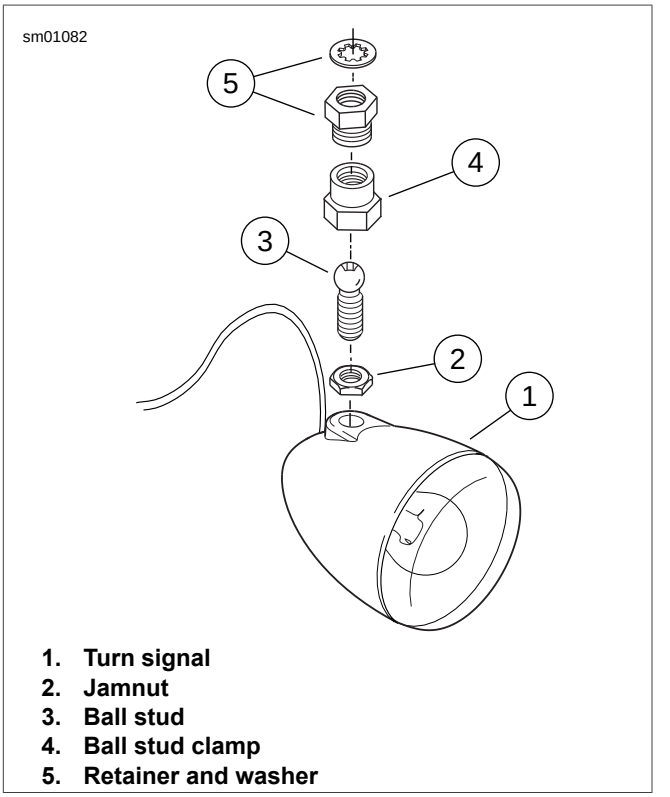
NOTE

Before removing turn signal wires, carefully note routing and location of each wire terminal in connector.

1. Remove rear fender. See 2.39 REAR FENDER.
2. See Figure 7-23. Australian market only: Remove splash guard (4).
3. Cut cable strap securing wiring to rear fender.
4. Remove light assembly (2).
5. Remove turn signal wire terminals from connector (1). See A.19 TYCO 070 MULTILOCK UNSEALED CONNECTOR.
6. Remove cable strap (5).
7. Remove turn signal housing from light assembly.
8. Install **new** turn signal housing, routing wiring harness through light assembly.
9. Tighten fasteners to 1.1-2.3 Nm. (9.7-20.3 **in-lbs**).
10. Install **new** cable strap (5).
11. Insert terminals into turn signal connector.
12. Install light assembly onto rear fender. Tighten fasteners to 1.5-2.0 Nm. (13.2-17.7 **in-lbs**)
13. Australian market only: Install splash guard (4).
14. See Figure 7-24. Route wiring through tunnel in rear fender and secure with cable strap.
15. Install rear fender.

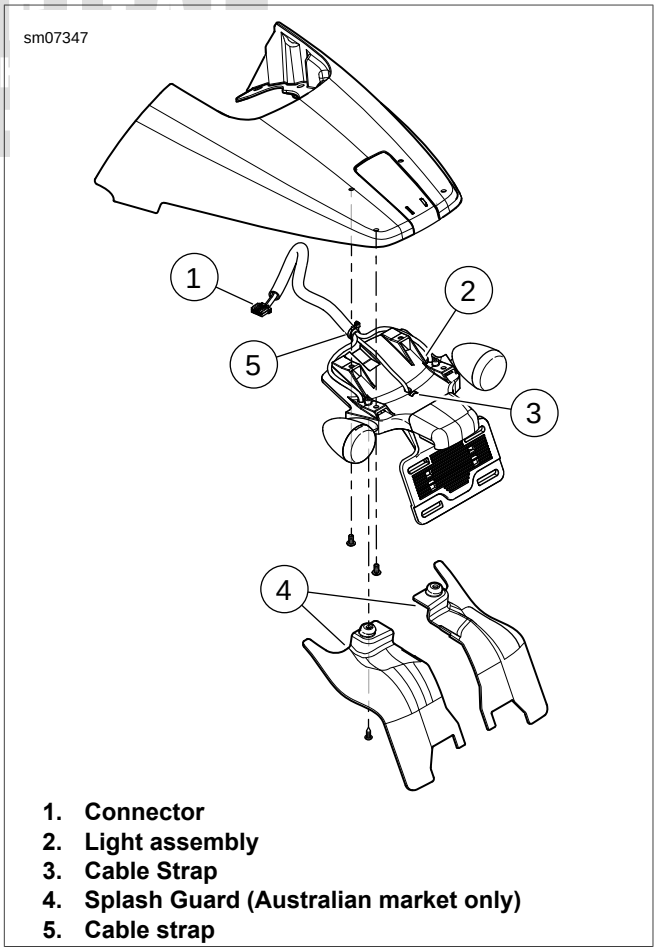
⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)



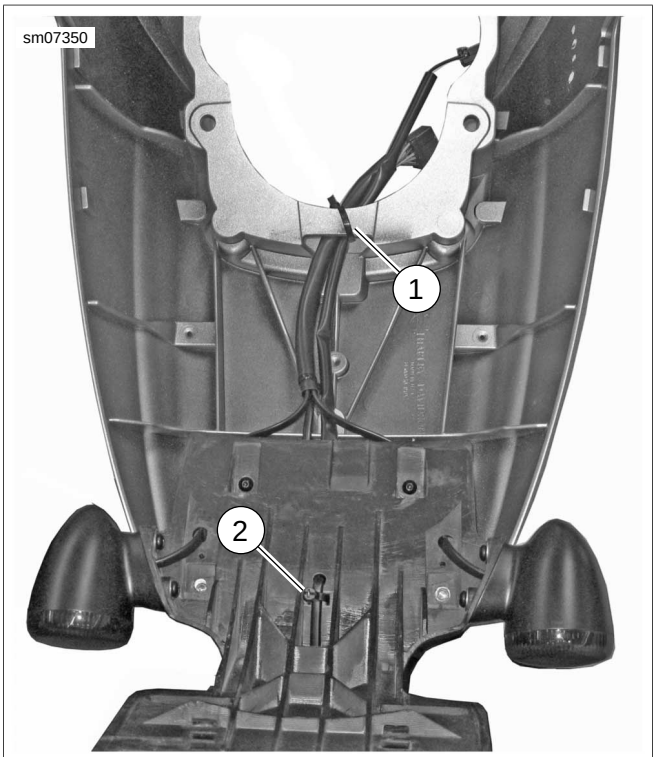
1. **Turn signal**
2. **Jamnut**
3. **Ball stud**
4. **Ball stud clamp**
5. **Retainer and washer**

Figure 7-22. Front Turn Signal Mounting



1. **Connector**
2. **Light assembly**
3. **Cable Strap**
4. **Splash Guard (Australian market only)**
5. **Cable strap**

Figure 7-23. Light Assembly

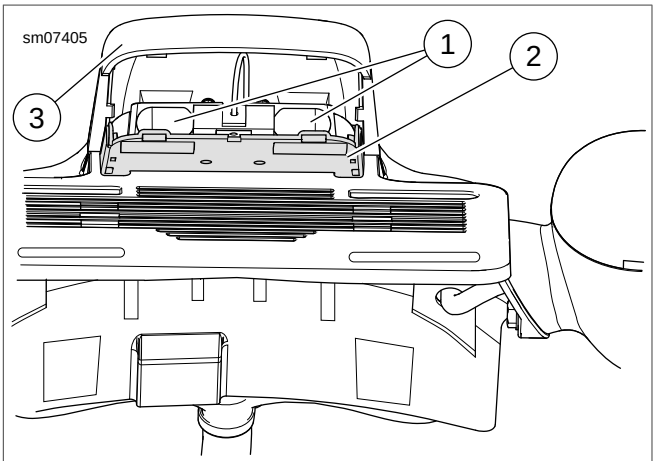


1. **Rear lighting wires cable strap**
2. **License Plate lamp wires cable strap**

Figure 7-24. Securing Wires

License Plate Bulbs

1. See Figure 7-25. Pry lens (2) from tabs on light assembly (3).
2. Remove bulbs (1).
3. Install **new** bulbs in sockets.
4. Install notches on lens under tabs in light assembly.



1. **Bulbs**
2. **Lens**
3. **Light assembly**

Figure 7-25. License Plate Bulbs: VRSCDX

License Plate Lamp

NOTE

Before removing license plate lamp wires, carefully note routing and location of each wire terminal in connector.

1. Remove rear fender. See 2.39 REAR FENDER.
2. See Figure 7-23. Australian market only: Remove splash guard (4).
3. Cut cable strap securing wiring to rear fender.
4. Remove light assembly (2).
5. Remove license plate wire terminals from connector (1). See A.19 TYCO 070 MULTILOCK UNSEALED CONNECTOR.
6. Remove cable strap (5).
7. See Figure 7-24. Remove cable strap (2).
8. Remove license plate lamp from light assembly.
9. Install **new** license plate lamp, routing wiring harness through light assembly. Tighten fasteners to 1.1-2.3 Nm. (9.7-20.3 **in-lbs**)
10. Install **new** cable strap (2).
11. See Figure 7-23. Install **new** cable strap (5).
12. Insert terminals into turn signal connector.
13. Install light assembly onto rear fender.
14. Australian market only: Install splash guard (4).
15. See Figure 7-24. Route wiring through tunnel in rear fender and secure with cable strap (1).
16. Install rear fender.

DIGITAL TECHNICIAN HARLEY-DAVIDSON

TURN SIGNALS: VRSCF 7.17

TURN SIGNAL REPLACEMENT

FASTENER	TORQUE VALUE	
Turn signal fastener	7.3-8.5 Nm	64.6-75.2 **in-lbs**
Mirror adjustment fastener	11-13 Nm	97-115 **in-lbs**

Front Turn Signals

NOTE

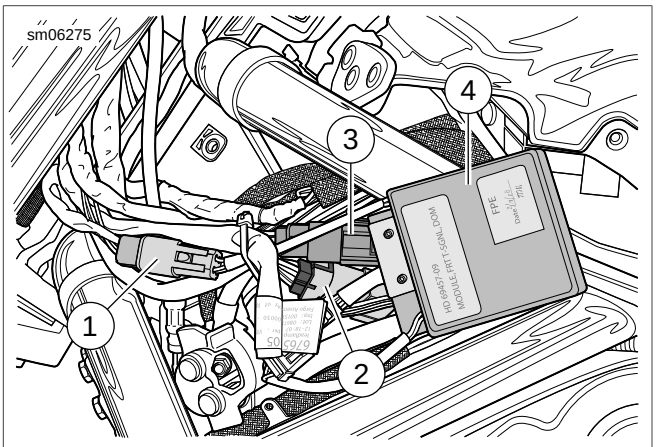
The turn signals are integrated into the mirror stems and are non-repairable LEDs. If a front turn signal fails, replace the mirror with the turn signal.

1. Remove right side cover and remove main fuse. See 7.6 MAIN FUSE.

NOTE

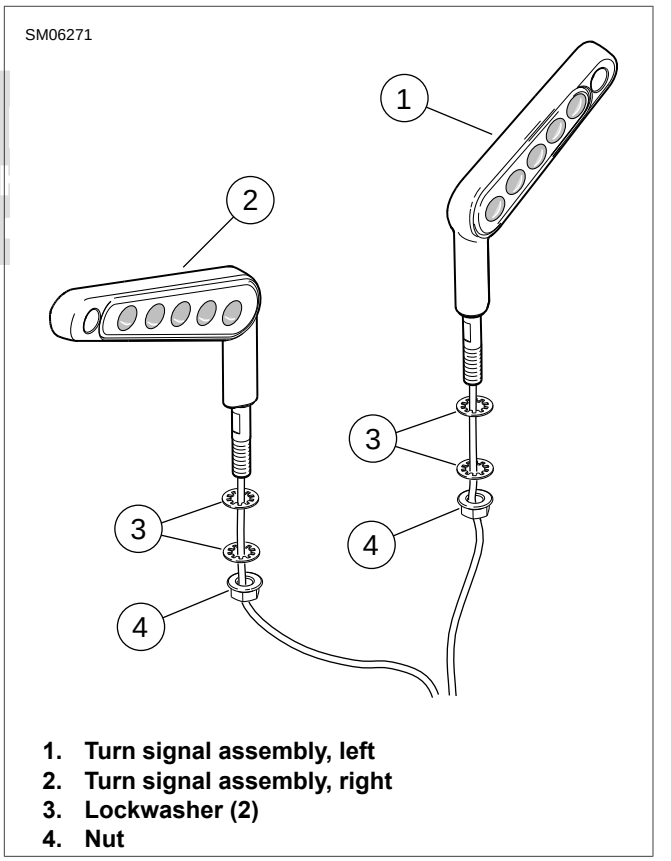
Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced if removed.

2. Remove left side cover.
3. See Figure 7-26. Separate front turn signal connector (1).
4. Note locations of turn signal wires in connector. Remove corresponding turn signal wire terminals from connector. See the electrical diagnostics manual for more information.
5. Separate clutch side or throttle and brake side switch housings. See 2.24 HAND GRIPS.
6. Wrap wire lead around end of turn signal wire and pull through routing hole in upper fork clamp. Leave wire lead in routing hole.
7. See Figure 7-27. Hold mirror stem and loosen nut (4) on turn signal stud. Do not remove turn signal.
8. Pull turn signal wire through the handlebar around handlebar controls and wire sheath.



1. **Front turn signal connector**
2. **Left handlebar controls connector**
3. **Right handlebar controls connector**
4. **Turn signal module**

Figure 7-26. Front Turn Signal and Handlebar Control Switch Connectors: VRSCF



1. **Turn signal assembly, left**
2. **Turn signal assembly, right**
3. **Lockwasher (2)**
4. **Nut**

Figure 7-27. Front Turn Signals: VRSCF

9. Remove lockwashers (3) and remove turn signal.
10. Lay old turn signal assembly next to **new** one and cut **new** wires to length. Trim sheath back approximately 63.5 mm (2.5 in) from ends of wires. See the electrical diagnostics manual for more information.

NOTE

Make all adjustments to mirrors before tightening fasteners.

11. Install **new** turn signal assembly and tighten nut to 7.3-8.5 Nm (64.6-75.2 **in-lbs**).
12. Adjust mirrors on turn signal assemblies and tighten fastener on back of mirror to 11-13 Nm (97-115 **in-lbs**).
13. Wrap wire lead around turn signal wires and route wire harness around handlebar controls and wire sheath through handlebar and pull through routing hole in upper fork clamp.
14. Crimp **new** pin terminals onto wires.
15. Insert terminals into turn signal connector and mate connector.
16. Install left side cover.
17. Install main fuse and right side cover.

Rear Turn Signals

NOTE

For rear turn signal service see 7.15 TAIL LAMP: VRSCF.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

CRANK POSITION SENSOR (CKP) 7.18

GENERAL

See Figure 7-28. The crank position sensor (CKP) (1) is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 22 teeth (2) machined in the left side rotor (3). Two consecutive teeth are missing in the flywheel to establish a reference point. The CKP sensor sends a signal to the ignition module. This signal is used to reference engine position (TDC) and engine speed. The CKP sensor is located near the lower front left corner of the engine crankcase.

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove left side radiator trim cover.
3. Clip and remove cable strap securing CKP sensor wiring harness to fan wiring harnesses.
4. Disconnect CKP sensor harness connector [79A].
5. See Figure 7-29. Unlatch cable clip (3) on top of jiffy stand bracket and remove CKP sensor cable harness.
6. Remove fastener and captive washer (2). Carefully remove CKP sensor and O-ring (1) from engine crankcase.

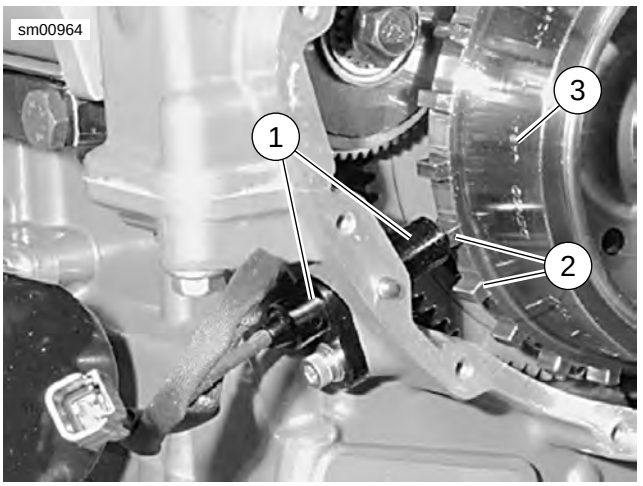
INSTALLATION

FASTENER	TORQUE VALUE	
Crank position sensor fastener	8.2-10.7 Nm	73-95 **in-lbs**

NOTE

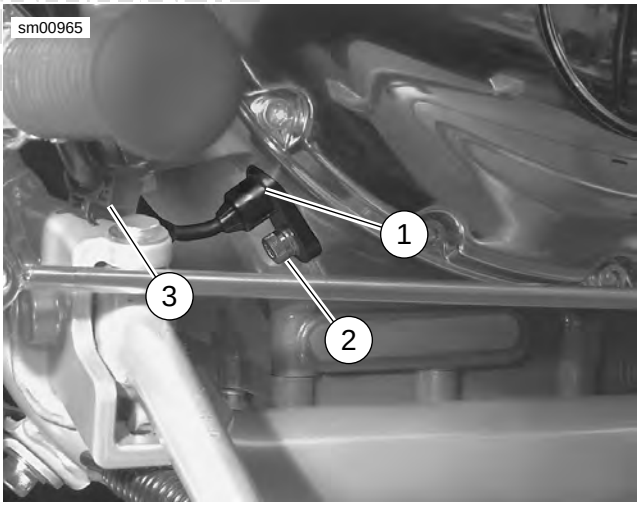
*The **new** CKP O-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the O-ring with engine oil to install it.*

1. See Figure 7-29. Install **new** CKP sensor and O-ring (1) with fastener and captive washer (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Route CKP sensor wiring harness through cable clip (3) on top of jiffy stand bracket. Latch cable clip.
3. Route CKP sensor wiring harness to wiring harness on left side of radiator and attach to connector [79B].
4. Secure CKP sensor wiring harness to fan wiring harnesses with **new** cable strap.
5. Install left side radiator trim cover. Make sure no wires become pinched under cover.
6. Replace main fuse and right side cover.
7. Start engine and verify operation.



1. **Crank position sensor**
2. **Sensor teeth**
3. **Rotor**

Figure 7-28. Rotor and Crank Position Sensor



1. **Crank position sensor and O-ring**
2. **Fastener with captive washer**
3. **Cable clip**

Figure 7-29. Crank Position Sensor Mounting (typical)

ALTERNATOR 7.19

GENERAL

The alternator is located behind the alternator cover, on the left side of the engine. The alternator consists of permanent magnets mounted around the circumference of a rotor and a series of radial wire coils statically mounted in a stator assembly. When rotated by the engine, the rotor magnets induce a voltage in the wire coils of the stator alternately reversing polls.

The rotor of the alternator is bolted to the crankshaft. On the crankshaft side of the rotor is a ball clutch mechanism that works in combination with the starter limiter gear to enable the starter ring gear and the rotor/crankshaft to rotate independently of each other. The circumference of the rotor is machined with teeth that identify a reference point for the crank position sensor (CKP).

The stator is bolted to the inside of the alternator cover and delivers induced voltage to a voltage regulator through a wire harness that passes through a boss in the side of the alternator cover.

The alternator cover is secured with 14 fasteners. The derby cover is located on the alternator cover, secured with two fasteners.

NOTE

For diagnostic information, see the electrical diagnostics manual.

⚠CAUTION

The high-output rotor contains powerful magnets. Exercise caution to prevent possible hand injury during removal and installation. (00558b)

REMOVAL

PART NUMBER	TOOL NAME
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45315	ALTERNATOR ROTOR REMOVER
HD-45340	GASKET ALIGNMENT DOWELS

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove fastener securing bottom of left radiator trim cover. Remove trim cover.
3. See Figure 7-30. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
4. Separate stator connector half [46A] from voltage regulator connector [46B] half.
5. Unlatch cable clip on top of jiffy stand and remove alternator wiring harness.

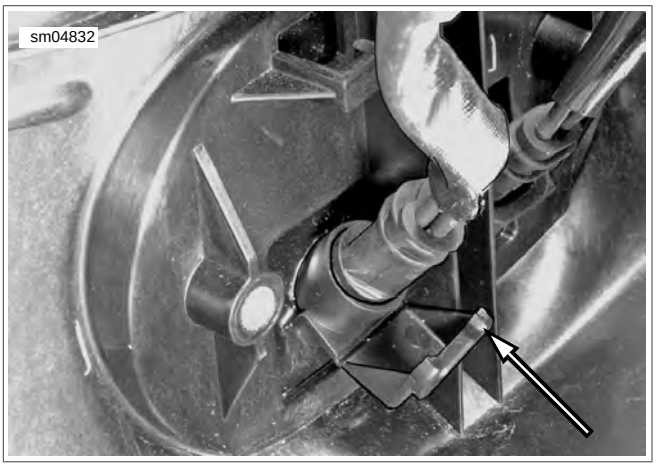
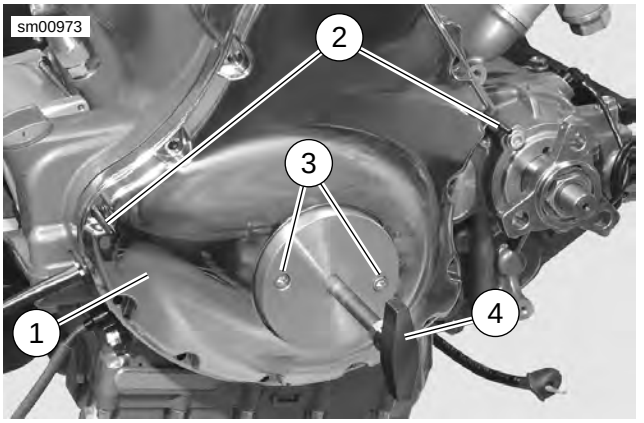


Figure 7-30. Voltage Regulator Connector Lock Clip

6. **VRSCF models:** Remove left side exhaust shield and loosen left muffler to allow clearance to remove alternator cover.
7. Remove two fasteners securing derby cover. Remove cover.
8. Place drip pan underneath alternator cover to catch any residual oil that may drain out when cover is removed.
9. Remove alternator cover fasteners in reverse order of torque sequence. See 7.19 ALTERNATOR, Installation.
10. Install two GASKET ALIGNMENT DOWELS (Part No. HD-45340) in two of the alternator cover holes to steady cover as it is removed.
11. See Figure 7-31. Using two inspection cover fasteners (3), position ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part No. HD-45304) (4) as shown.
12. Remove the alternator cover.
13. Inspect rotor for wear or damage. The rotor and ball clutch assembly for the starter ring gear are replaced as one assembly.
14. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.
15. Install ALTERNATOR ROTOR REMOVER (Part No. HD-45315) and hand tighten.
16. See Figure 7-32. Use an impact socket and wrench to tighten the tool removing the rotor from the crankshaft taper.



1. **Alternator cover**
2. **Gasket alignment dowel (2)**
3. **Derby cover fasteners**
4. **Alternator cover remover/installer tool (HD-45304)**

Figure 7-31. Removing Alternator Cover

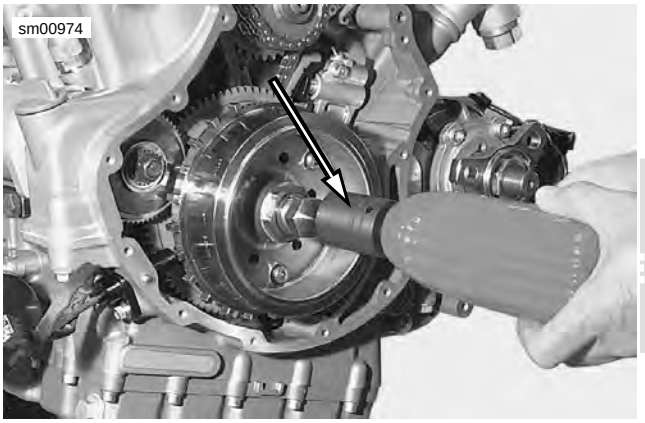
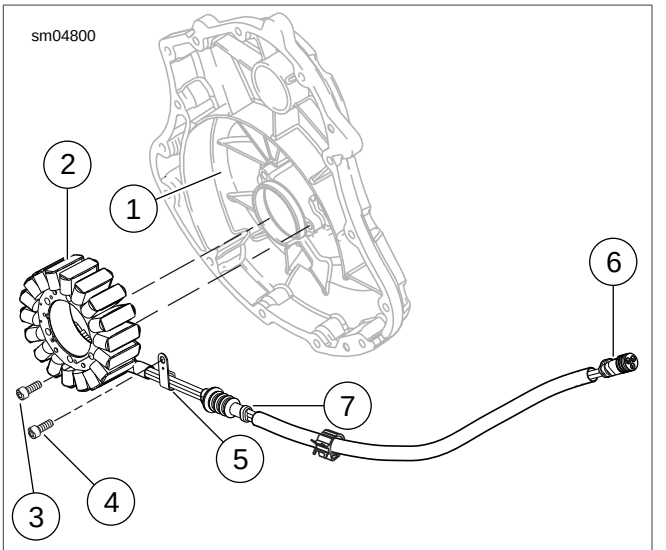


Figure 7-32. Alternator Rotor Remover (HD-45315)

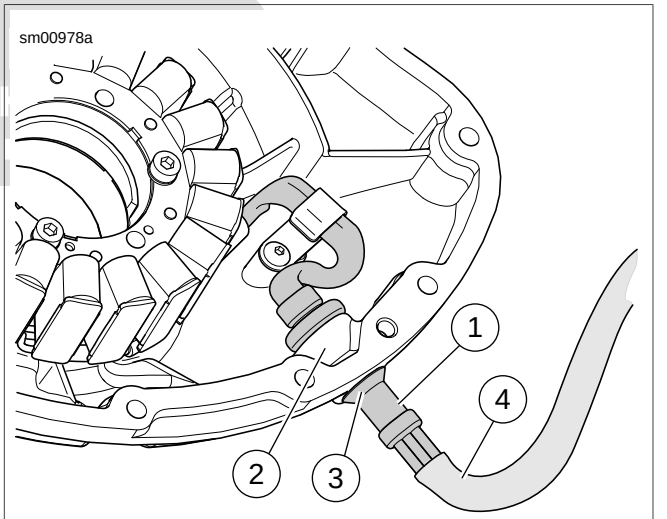
DISASSEMBLY

1. See Figure 7-33. Remove fastener (4) and wire harness clip (5) from alternator cover (1).
2. Remove stator mounting fasteners (3) and captive washers from stator (2). Remove three stator mounting fasteners (3) and pull stator straight up out of alternator cover (1). Note orientation of slot in cover stator hub and clip on stator.
3. See Figure 7-34. While pushing on grommet (1) from outside of alternator cover, rock grommet back and forth to facilitate removal. Exercise caution to avoid damaging rib (3) on grommet if stator is to be reused.
4. Draw stator wire harness (4) and socket terminals through alternator cover bore.
5. Remove stator and wire harness from alternator cover.



1. **Alternator cover**
2. **Stator**
3. **Stator mounting fasteners (3)**
4. **Fastener**
5. **Harness clip**
6. **Harness connector**
7. **Grommet**

Figure 7-33. Removing Stator From Alternator Cover



1. **Grommet**
2. **Boss**
3. **Rib**
4. **Wire harness**

Figure 7-34. Stator Wiring Harness Grommet

ASSEMBLY

FASTENER	TORQUE VALUE	
Stator mounting fastener	8.2-10.7 Nm	72-95 **in-lbs**
Alternator cover harness clip fastener	8.2-10.7 Nm	72-95 **in-lbs**

1. Thoroughly clean alternator cover and gasket sealing surface on engine case. Remove all sealing material from gasket sealing surfaces.
2. See Figure 7-34. From inside cover, feed stator wire harness (4) through boss (2) on cover wall.
3. Lubricate grommet (1) with isopropyl alcohol or glass cleaner. Grommet must be clean and free of dirt and oily residue.
4. Push grommet into bore in boss while carefully pulling on outside wire harness.
5. See Figure 7-33. With stator (2) oriented to cover (1) so that wire harness exits alternator cover at approximately 3 o'clock, line up three fastener holes in stator with holes in alternator cover (1).
6. Install three stator mounting fasteners (3) and alternately tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
7. Install harness clip (5) over wire harness into alternator cover. Secure with fastener (4). Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).

INSTALLATION

PART NUMBER	TOOL NAME
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL
HD-45314	CRANKSHAFT ROTATING WRENCH
HD-45340	GASKET ALIGNMENT DOWELS

FASTENER	TORQUE VALUE	
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs
Alternator cover fastener	9.7 Nm	86 **in-lbs**
Derby cover fastener	8.2-10.7 Nm	72-95 **in-lbs**
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**

NOTE

Check that woodruff key is in place during assembly.

1. Install rotor shell with the integral ball clutch.
2. See Figure 7-35. Hold the rotor with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) and tighten rotor bolt to 83 Nm (61 ft-lbs) then loosen one full turn.
3. Final tighten to 180 Nm (132 ft-lbs).
4. See Figure 7-31. Make sure ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part No. HD-45304) (4) is installed as shown. Secure to alternator cover with two derby cover fasteners. Turn handle of tool clockwise (CW) several turns.
5. Make sure two GASKET ALIGNMENT DOWELS (Part No. HD-45340) (2) are installed in case.
6. Slide **new** alternator cover gasket onto alignment dowels and press flush against engine case.
7. Slide alternator cover onto alignment dowels. Turn handle of remover/installer counterclockwise (CCW) until it turns freely. Remove two derby cover fasteners and remover/installer tool.

NOTE

To avoid oil leaks caused by warping of alternator cover, in next step, tighten fasteners in alternating pattern back and forth across face of cover. See Figure 7-36.

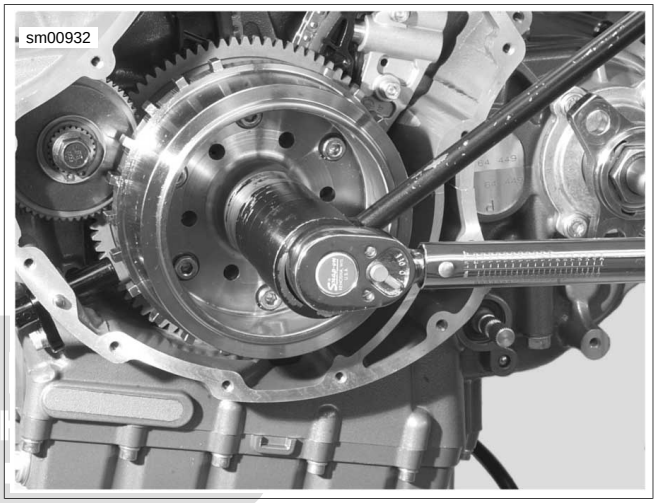


Figure 7-35. Install Rotor Shell

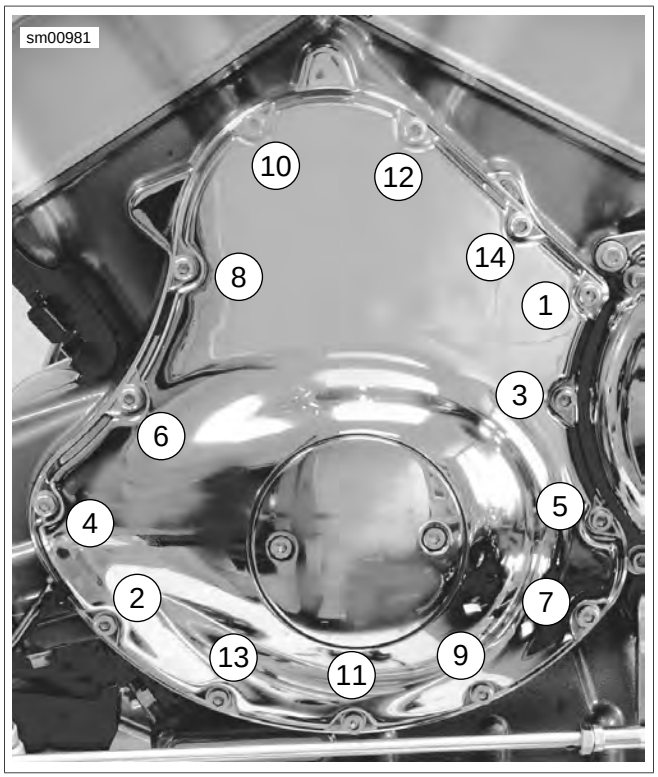


Figure 7-36. Alternator Cover Torque Sequence

8. See Figure 7-36. Secure alternator cover to engine case with 14 fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
9. Clean derby cover. Inspect O-ring on derby cover. Replace if damaged.
10. Install derby cover on alternator cover with two fasteners. Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
11. Route stator wiring harness through cable clip on top of jiffy stand. Latch cable clip.
12. Plug stator connector into three-wire voltage regulator connector. Secure connector to left side of radiator cover with connector clip.
13. Install radiator trim cover onto radiator cover. Make sure no wires become pinched under cover. Secure with fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
14. **VRSCF models:** Install left side exhaust shield and tighten left muffler.
15. Install main fuse and right side cover.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

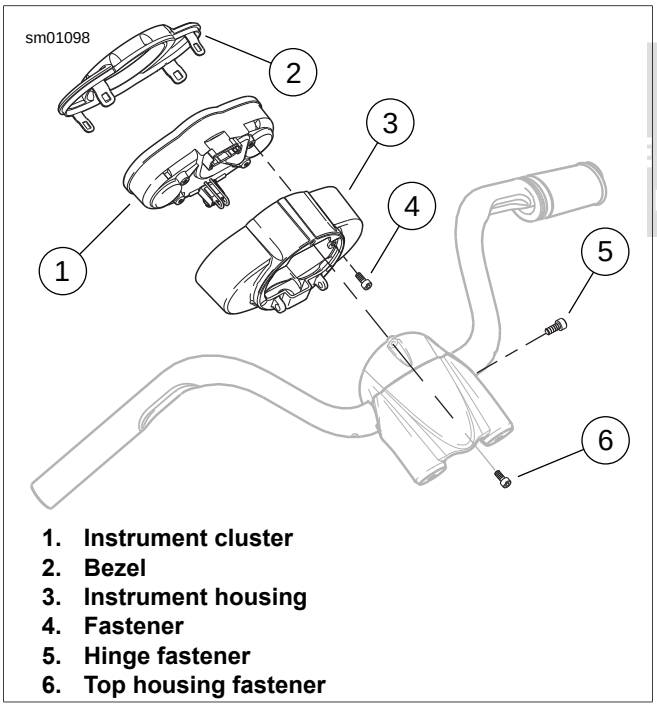
INSTRUMENT CLUSTER: VRSCDX 7.20

GENERAL

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the entire instrument cluster must be replaced.

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. See Figure 7-37. Remove fastener (6) at top of instrument housing.
3. Holding instrument housing to prevent damage to air box cover, rotate housing open.
4. See Figure 7-38. Squeeze two release latches together and pull wiring harness connector [39B] from instrument cluster.
5. See Figure 7-37. Loosen and remove hinge fastener (5) and slide housing off of hinge peg.
6. Remove four fasteners and separate housing, instrument cluster and bezel.



1. **Instrument cluster**
2. **Bezel**
3. **Instrument housing**
4. **Fastener**
5. **Hinge fastener**
6. **Top housing fastener**

Figure 7-37. Instrument Cluster (typical)

INSTALLATION

FASTENER	TORQUE VALUE	
Instrument cluster to housing fasteners	1.3-1.9 Nm	12-16 **in-lbs**
Instrument housing hinge fastener	2.2-2.8 Nm	20-24 **in-lbs**
Top housing fastener	2.2-2.8 Nm	20-24 **in-lbs**

1. See Figure 7-37. Assemble bezel, instrument cluster and housing. Install and tighten fasteners (4) to 1.3-1.9 Nm (12-16 **in-lbs**).
2. Fit hinge of housing to peg on handlebar clamp. Install and tighten fastener (5) to 2.2-2.8 Nm (20-24 **in-lbs**).
3. Squeeze two release latches together and mate connector [39B] to instrument cluster.
4. Close housing. Install and tighten top housing fastener to 2.2-2.8 Nm (20-24 **in-lbs**).
5. Replace main fuse and right side cover.
6. Verify that instrument cluster is operational:
 a. Turn ignition switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
 b. Turn ignition switch to the OFF position.

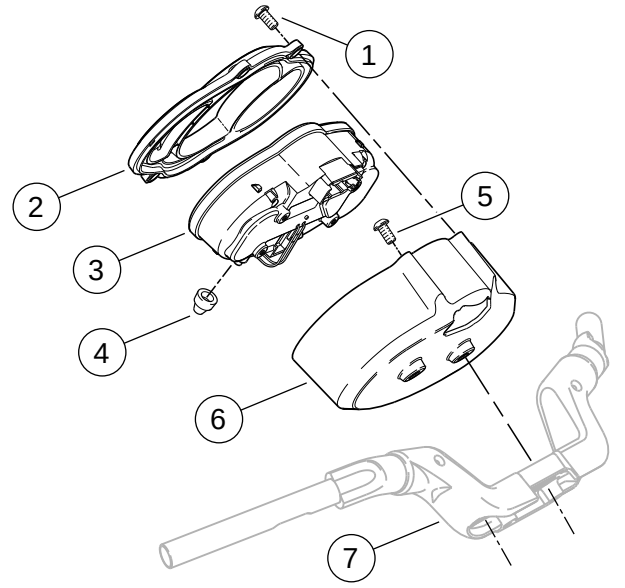


Figure 7-38. Instrument Cluster Connector [39B]

INSTRUMENT CLUSTER: VRSCF 7.21

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Remove headlamp. See 7.13 HEADLAMP.
3. Remove wiring harness connector [39] from instrument cluster socket.



1. **Screw, instrument cluster bezel (4)**
2. **Bezel, instrument cluster**
3. **Instrument cluster**
4. **Reset switch boot**
5. **Screw, instrument cluster housing to handlebars (2)**
6. **Instrument cluster housing**
7. **Handlebars**

Figure 7-39. Instrument Cluster: VRSCF

4. See Figure 7-39. Remove the four screws (1) securing the bezel (2) to the instrument cluster housing (6) and remove bezel.
5. Remove reset switch boot (4) and remove instrument cluster (3) from housing (6).

INSTALLATION

FASTENER	TORQUE VALUE	
Instrument cluster housing screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**
Instrument cluster screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**
Headlamp bracket fastener	11-18 Nm	8-13 ft-lbs

1. Fasten instrument cluster housing (6) with two screws (5) to handlebars (7) and tighten screws to 4.1-6.8 Nm (36.3-60.2 **in-lbs**).
2. Install instrument cluster (3) into housing (6) and install reset switch boot (4).
3. Orient instrument cluster bezel (2) onto instrument cluster housing (6) making sure gauges are clearly visible and fasten with four screws (1). Tighten screws to 4.1-6.8 Nm (36.3-60.2 **in-lbs**).
4. Install wiring harness connector [39] into instrument cluster socket.
5. Install headlight assembly and tighten headlamp bracket fasteners to 11-18 Nm (8-13 ft-lbs).
6. Replace main fuse and right side cover.
7. Verify that instrument cluster is operational:
 a. Turn ignition switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
 b. Turn ignition switch to the OFF position.

VEHICLE SPEED SENSOR (VSS) 7.22

GENERAL

The vehicle speed sensor (VSS) is a hall effect sensor that takes readings off a drive gear in the transmission.

The VSS is located behind the rear cylinder on the back of the engine case, below the cam chain tension adjuster.

REMOVAL

1. Remove right side cover and main fuse.
2. See Figure 7-40. Disconnect VSS wiring harness cable connector [65B] from the VSS.
3. Remove the fastener securing the VSS. Carefully pull the VSS and O-ring straight out of the transmission case.

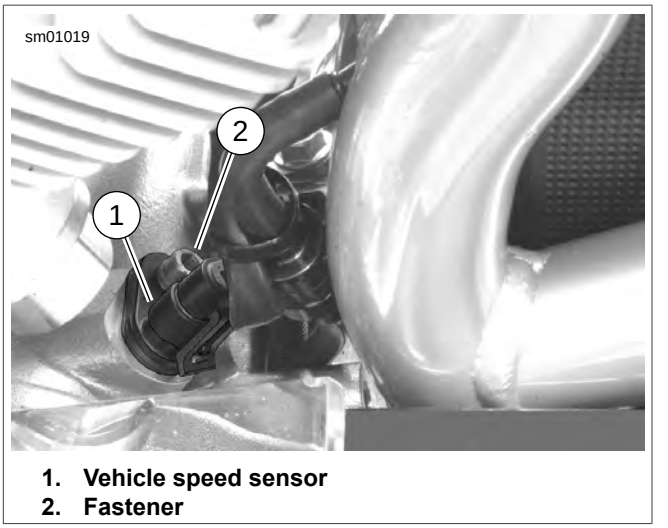
INSTALLATION

FASTENER	TORQUE VALUE	
VSS mounting fastener	8.2-10.7 Nm	73-95 **in-lbs**

NOTE

*The **new** VSS O-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the O-ring with engine oil to install it.*

1. See Figure 7-40. Install **new** VSS with O-ring and fastener (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Connect harness connector [65] to VSS.
3. Install main fuse and side cover.



1. Vehicle speed sensor
2. Fastener

Figure 7-40. Vehicle Speed Sensor (typical)

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

NEUTRAL SWITCH 7.23

GENERAL

The neutral switch is located on the bottom of the engine case near the rear of the engine. The two-terminal switch is normally closed. When the transmission is in neutral and the ignition switch is in the IGN position, the neutral switch causes the NEUTRAL indicator lamp to illuminate.

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Make sure transmission is shifted into NEUTRAL.
3. Place a clean container under motorcycle to catch any oil that may escape.
4. See Figure 7-41. Remove two wiring harness connectors (2) from neutral switch (1). Gently pull connectors straight off switch studs.
5. Using a 7/8 in. socket wrench, remove neutral switch and o-ring from engine case.

INSTALLATION

FASTENER	TORQUE VALUE	
Neutral switch	12.8-16.5 Nm	113-146 **in-lbs**

NOTE

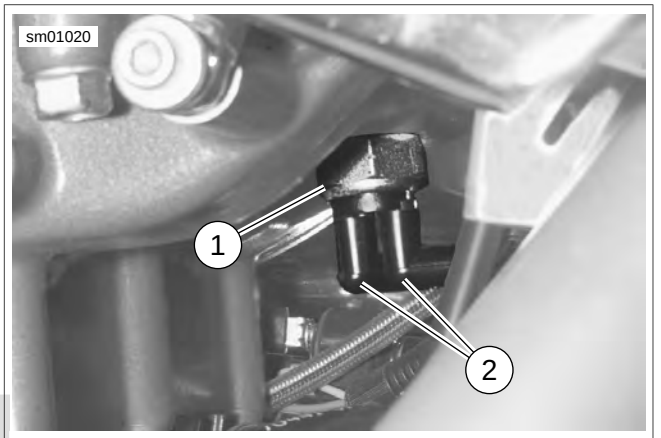
The transmission shifter must be in the NEUTRAL position when installing the switch to allow the switch ball to engage the shifter cam ramp.

1. See Figure 7-42. Lubricate **new** O-ring (2) with engine oil.
2. Install neutral switch with O-ring into engine case. Tighten to 12.8-16.5 Nm (113-146 **in-lbs**).

NOTE

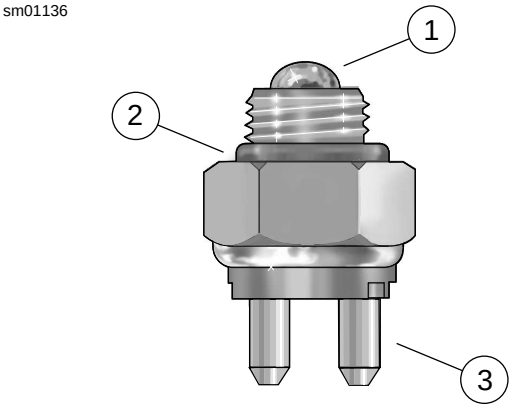
The neutral switch is not polarity sensitive. Either connector may be attached to either stud.

3. See Figure 7-41. Install wiring harness connectors (2) onto studs on neutral switch (1). Gently push connectors until they bottom out on studs.
4. Replace main fuse and right side cover.
5. Test neutral switch for proper operation.
 a. Turn ignition switch to IGN position.
 b. Verify that transmission shifter is in NEUTRAL.
 c. Check to see that NEUTRAL indicator lamp illuminates.
 d. Turn off ignition switch.
6. If any oil escaped while neutral switch was removed from vehicle, check the engine oil level. See 1.6 ENGINE OIL AND FILTER. Replenish engine oil as necessary.



1. **Neutral switch**
2. **Wiring harness connectors (2)**

Figure 7-41. Neutral Switch Location (typical)



1. **Ball**
2. **O-ring**
3. **Switch stud**

Figure 7-42. Neutral Switch (typical)

OIL PRESSURE SWITCH 7.24

GENERAL

The oil pressure switch monitors oil pressure in the crankcase. If the oil pressure drops below 13.8-34.5 kPa (2-5 psi), the oil pressure switch is tripped and illuminates the low oil pressure indicator light. The oil pressure switch is located in the valley on top of the engine crankcase between the cylinders.

REMOVAL

PART NUMBER	TOOL NAME
HD-45300	OIL PRESSURE SWITCH SOCKET

1. Open seat.
2. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.

NOTICE

Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect negative battery cable. See 1.24 BATTERY MAINTENANCE.
4. Remove horn assembly. See 7.26 HORN.
5. Remove MAP sensor. See 4.7 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP).
6. Remove the idle air control (IAC) motor wiring harness connector [87B] and throttle position sensor (TPS) connector [88B] from the fuel injector assembly. Tuck the wiring harnesses back out of the way.
7. See Figure 7-43. Remove the wiring harness connector [120] from the oil pressure switch.

NOTES

- *The engine in the figure has been stripped to clarify the location of the oil pressure switch.*
- *It will be necessary to use a universal adapter and extension with the oil pressure switch socket in the next step to fully seat the socket on the oil pressure switch. In place of a universal adapter and standard extension, a Snap-on Wobble Extension, such as the FXW8 or FXW11A may be used.*
- *When removing the oil pressure switch, take care to avoid damaging wiring connectors and sensor bodies located nearby.*

8. Using OIL PRESSURE SWITCH SOCKET (Part No. HD-45300), remove the oil pressure switch.

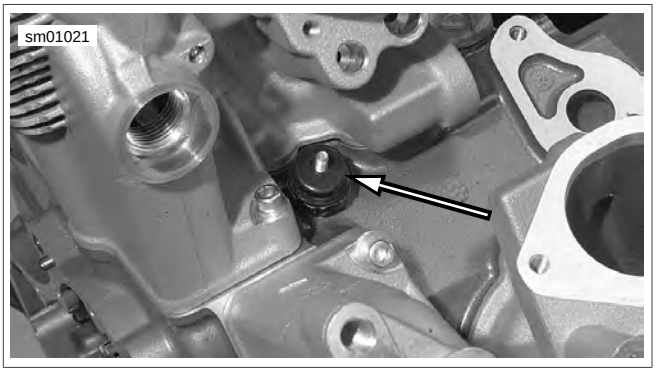


Figure 7-43. Oil Pressure Switch (typical)

INSTALLATION

PART NUMBER	TOOL NAME
HD-45300	OIL PRESSURE SWITCH SOCKET

FASTENER	TORQUE VALUE	
Oil pressure switch	10.8-13.6 Nm	96-120 **in-lbs**
Battery terminal bolt	6.8-7.9 Nm	60-70 **in-lbs**

NOTE

*Perform step 1 below only if original oil pressure switch is being installed again. **New** switches have a sealant contact patch on the threads. If **new** switch is being installed, begin with step 2.*

1. Coat threads of oil pressure switch with LOCTITE 565 THREAD SEALANT.
2. Using OIL PRESSURE SWITCH SOCKET (Part No. HD-45300), install oil pressure switch. Tighten to 10.8-13.6 Nm (96-120 **in-lbs**).
3. Attach wiring connector [120] to oil pressure switch.
4. Attach IAC motor and TPS sensor wiring harness connectors [87B] and [88B].
5. Install MAP sensor. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
6. Install horn assembly. See 7.26 HORN.
7. Connect negative battery cable. Tighten bolt to 6.8-7.9 Nm (60-70 **in-lbs**). See 1.24 BATTERY MAINTENANCE.
8. Remove duct tape from injector intakes.
9. Install air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
10. Test oil pressure switch for proper operation.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

REAR STOPLIGHT SWITCH 7.25

GENERAL

The stoplight switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stoplight switch is tripped and illuminates the stop light. The stoplight switch is located on the rear brake line T-fitting.

NOTE

For models equipped with ABS, see C.4 ABS BRAKE LINES.

REMOVAL

1. Remove right side cover and main fuse. See 7.6 MAIN FUSE.
2. Open seat.
3. Remove exhaust. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF.
4. See Figure 7-44. Remove wiring harness terminal connectors (1) [121] from stoplight switch (2).
5. Place a clean container under stoplight switch and brake line to catch escaping fluid.
6. Using an open end wrench, remove stoplight switch from T-fitting (3).

INSTALLATION

FASTENER	TORQUE VALUE	
Stoplamp switch	8.5-11.5 Nm	75.2-101.7 **in-lbs**

NOTE

*Perform step 1 below only if original rear stop lamp switch is being re-installed. **New** switches have a sealant contact patch on the threads. If **new** switch is being installed, begin with step 2.*

1. Coat threads of stop lamp switch with LOCTITE 565 THREAD SEALANT.
2. See Figure 7-44.Install stoplamp switch (2) to brake line T-fitting (3). Tighten switch to 8.5-11.5 Nm (75.2-101.7 **in-lbs**) .
3. Attach wiring harness terminal connectors (1) [121] to stop lamp switch.
4. Install exhaust. See 4.14 EXHAUST SYSTEM: VRSCDX or 4.15 EXHAUST SYSTEM: VRSCF..
5. Close seat.

⚠WARNING

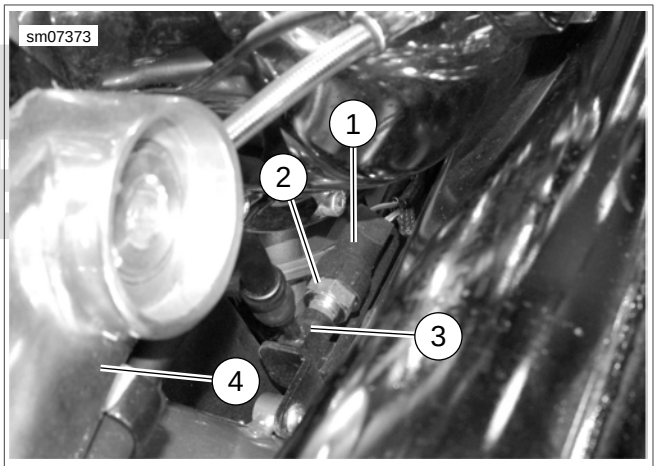
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

6. Bleed brake system. See 2.21 BLEEDING BRAKES.
7. See 7.6 MAIN FUSE.Replace main fuse.
8. Install right side cover.

⚠WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

9. Check tail lamp/stop lamp for proper operation.



1. **Wiring harness terminal connector**
2. **Stoplight switch**
3. **Rear brake line T-fitting**
4. **Rear fork**

Figure 7-44. Stoplight Switch (Non-ABS shown)

HORN 7.26

INSPECTION

The horn is located on the left side of the motorcycle, mounted under the top frame rail, between the engine cylinder heads.

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed or damaged horn terminal wires, discharged battery or corroded ground.

The horn is permanently sealed and non-repairable. If defective, it must be replaced.

NOTE

No tonal adjustments can be made to this horn.

REPLACEMENT

FASTENER	TORQUE VALUE	
Horn flange nut	6-8 Nm	53-70 **in-lbs**
Horn assembly acorn nut	9-15 Nm	80-132 **in-lbs**

1. See Figure 7-45. Remove acorn nut (3), harness mount bracket (13) and detach horn assembly from motorcycle.
2. Note location, and remove wires from connections on back side of horn (9).
3. Remove nut (6) securing horn to mounting bracket (11).

NOTES

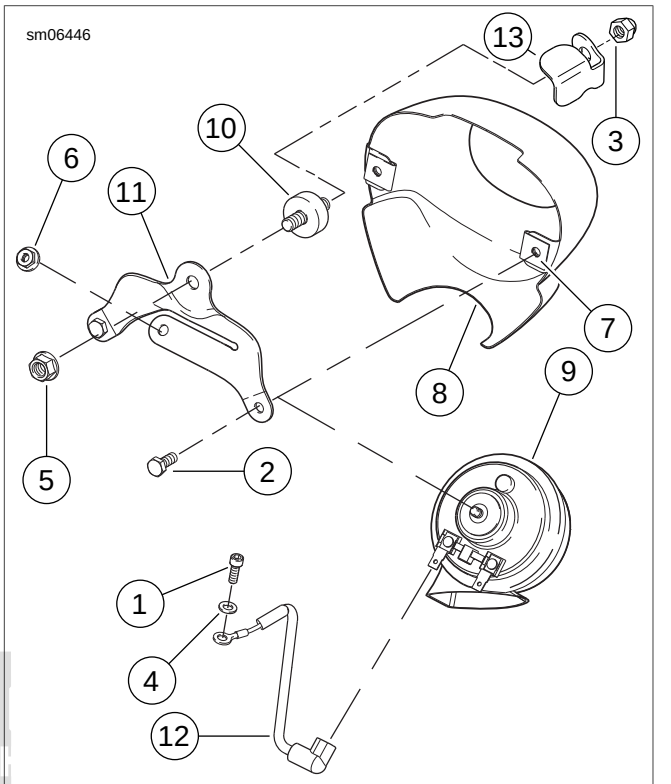
- *When tightening the nut in the next step, make certain the horn does not come in contact with the horn cover. If it does, loosen the flange nut, reposition the horn, and retighten the nut.*
- *Over-tightening the nut (6) can cause permanent horn damage. This results in reduced volume and tone quality.*

4. Install **new** horn on bracket (11). Secure with nut (6). Tighten to 6-8 Nm (53-70 **in-lbs**).

NOTES

- *Improperly installed horn can strike fins on the cylinder heads during operation. The interference can cause substantial cosmetic damage.*
- *When tightening the acorn nut, make certain the horn cover does not come in contact with the fins on the cylinder heads. If it does, loosen the acorn nut, reposition the horn assembly and tighten the nut.*

5. See Figure 7-45. Attach horn assembly to motorcycle using mount (10), harness mount bracket (13) and acorn nut (3). Tighten to 9-15 Nm (80-132 **in-lbs**).



1. **Screw**
2. **Screw (2)**
3. **Acorn nut**
4. **Washer**
5. **Locknut**
6. **Nut**
7. **Nut (2)**
8. **Horn cover**
9. **Horn**
10. **Mount**
11. **Bracket**
12. **Ground wire**
13. **Harness mount bracket**

Figure 7-45. Horn (typical)

COOLING FANS 7.27

REMOVAL

⚠CAUTION

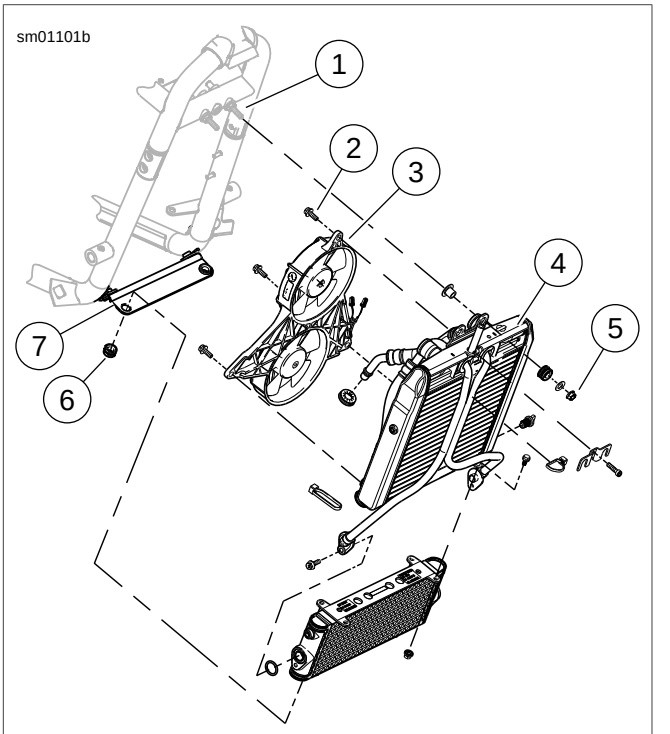
Cooling fans operate automatically, even when the ignition switch is off. Keep hands away from fan blades. Contact with a rotating fan blade can result in minor or moderate injury. (00093a)

1. Remove right side cover and main fuse.
2. Remove fastener and right radiator trim cover.
3. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
4. Remove fastener and left radiator trim cover.

NOTE

Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

5. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover.
6. Remove radiator cover.
7. Disconnect voltage regulator connectors [47] and [77].
8. See Figure 7-46. Remove front cross member (7).
9. Loosen upper fasteners (5).
10. See Figure 7-47. Disconnect fan assembly connectors (3) [97B] and [97T].
11. Remove fasteners securing fan assembly to radiator.
12. Pull lower portion of radiator away from frame and remove fan assembly.



1. **Frame radiator mounting studs**
2. **Fan fasteners**
3. **Cooling fan assembly**
4. **Radiator**
5. **Fasteners**
6. **Cross member grommet**
7. **Cross member**

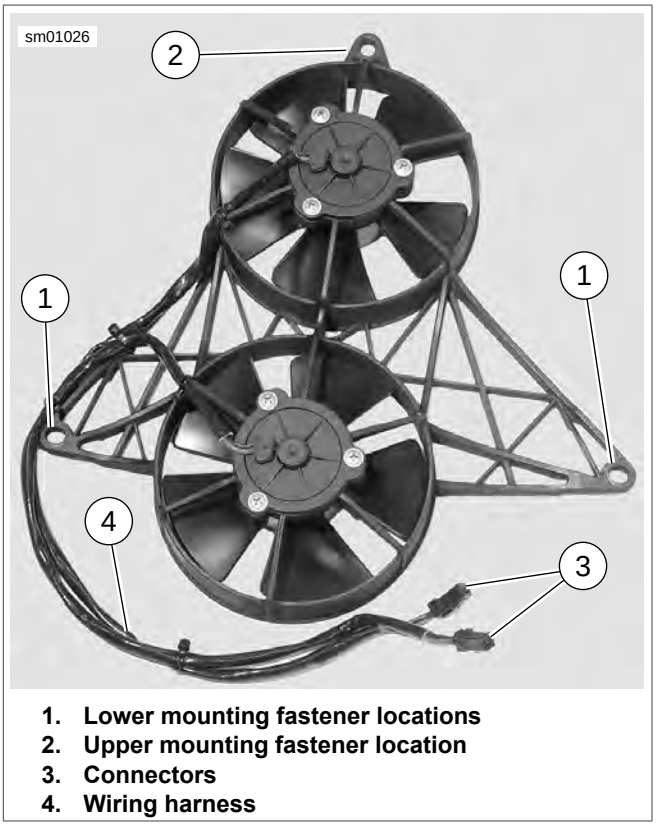
Figure 7-46. Radiator Mounting (typical)

INSTALLATION

FASTENER	TORQUE VALUE	
Cooling fan fasteners	5-7 Nm	44-62 **in-lbs**
cross member fasteners	20-26 Nm	14.7-19.2 ft-lbs
upper cooling fan fastener	19-27 Nm	14.0-19.9 ft-lbs
Radiator cover fasteners	4.1-6.8 Nm	36-60 **in-lbs**
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**

1. See Figure 7-47. Install cooling fan assembly with fan wiring harness to left side of radiator.
2. See Figure 7-46. Thread in and tighten fan fasteners to 5-7 Nm (44-62 **in-lbs**).
3. Install front cross member. Tighten fasteners to 20-26 Nm (14.7-19.2 ft-lbs).
4. See Figure 7-47. Tighten upper cooling fan fastener to 19-27 Nm (14.0-19.9 ft-lbs).

5. Connect fan assembly connectors [97B] and [97T].
6. Connect voltage regulator connectors [47] and [77].
7. Mount radiator cover with fasteners and washers. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).
8. Install left side radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
9. Push rear brake master cylinder reservoir into mounting slots in right side of radiator cover.
10. Install right radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
11. Replace main fuse and right side cover.
12. Test cooling fan operation. See electrical diagnostics manual.



1. **Lower mounting fastener locations**
2. **Upper mounting fastener location**
3. **Connectors**
4. **Wiring harness**

Figure 7-47. Cooling Fan Assembly

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

HANDLEBAR SWITCH ASSEMBLIES 7.28

GENERAL

The switches are of rugged construction and feature a superior seal to protect electrical contacts and components from dirt and moisture in harsh environments.

The left handlebar switches include the headlamp HI - LO switch, horn and left turn signal switch. The right handlebar switches include the engine start and RUN - OFF switch and right turn signal switch. The individual switches are non-repairable and must be replaced if they malfunction.

NOTES

- *On certain models, the turn signal wiring is routed through the lower switch housings and handlebars.*
- *To replace or repair individual switches in either the right or left handlebar switch assemblies, see 7.29 RIGHT HANDLEBAR SWITCH or 7.30 LEFT HANDLEBAR SWITCH.*

REPAIR PROCEDURES

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

See 7.29 RIGHT HANDLEBAR SWITCH and 7.30 LEFT HANDLEBAR SWITCH. The removal and installation steps listed apply when replacing the entire switch assembly, a switch housing or the handlebar.

1. To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 177.8 mm (7.0 in) cable strap in kit.
2. Strip 12.7 mm (0.5 in) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.
3. Cut dual wall heat-shrink tubing, supplied in repair kit into 25.4 mm (1.0 in) segments. Slide tubing over each wire of **new** switch assembly.
4. Splice existing and **new** switch wires, matching wire colors. Solder the spliced connections. For best results, splice one wire at a time.
5. Center the heat-shrink tubing over the soldered splices.

⚠WARNING

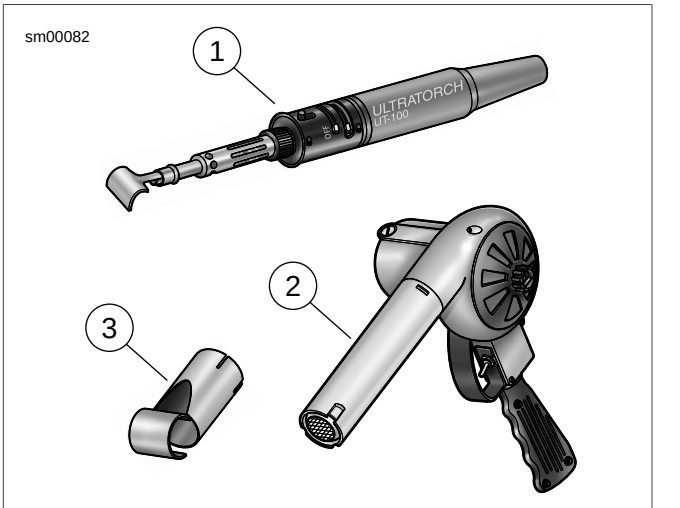
Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

6. See Figure 7-48. Using the ULTRA TORCH UT-100 (Part No. HD-39969) or ROBINAIR HEAT GUN (Part No. HD-25070) with HEAT SHIELD ATTACHMENT (Part No. HD-41183) or other suitable radiant heating device, uniformly heat the heat-shrink tubing to insulate and seal the soldered connections. Apply heat just until the meltable sealant exudes out both ends of tubing and it assumes a smooth cylindrical appearance.
7. Inspect the melted sealant for solder beads. Excess solder or heat may force some solder out with the melted sealant. Use a small needle nose pliers to remove any solder found. Briefly heat the connection to reseal the tubing if solder beads were removed. Use less solder or reduce heating time or intensity when doing subsequent splices.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)



1. **Ultra Torch UT-100**
2. **Robinair Heat Gun**
3. **Heat Shield Attachment**

Figure 7-48. Radiant Heating Devices

RIGHT HANDLEBAR SWITCH 7.29

REMOVAL

NOTE

The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.

1. Remove right side cover and remove main fuse.
2. See Figure 7-49. If removing the switch housing and wire harness, remove the left side cover and locate the right switch housing connector [22].
3. Press the latch on the socket housing and separate the switch housing connector halves.
4. Remove secondary locking wedge and press terminal latches inside socket housing to remove socket terminals and wires.

NOTICE

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

5. See Figure 7-50. Place the cardboard insert between the brake lever and lever bracket.
6. Remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.
7. Remove the upper and lower switch housing screws.

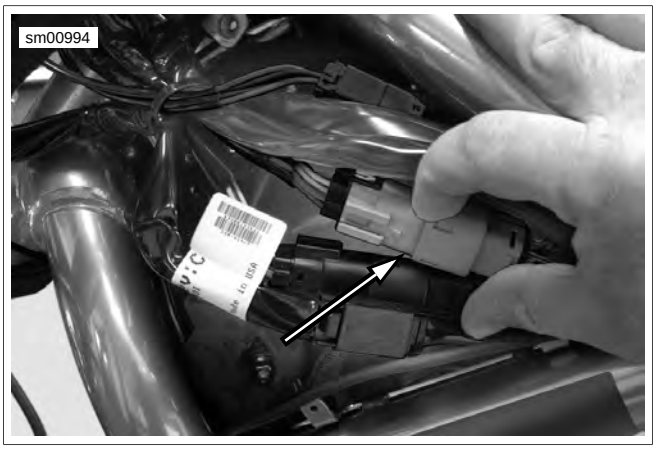


Figure 7-49. Right Switch Housing Connector [22] (typical)

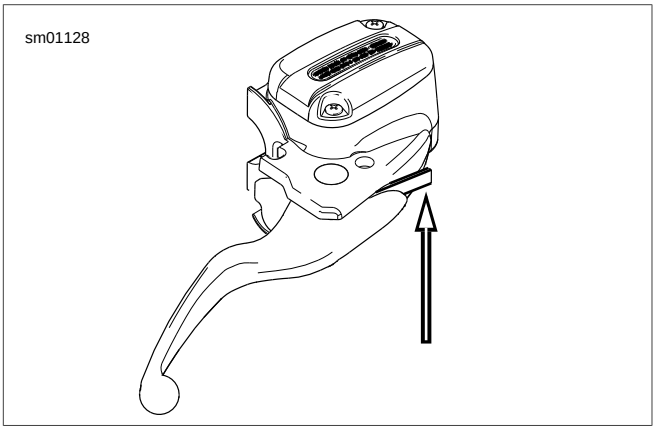


Figure 7-50. Install 4 mm (5/32 in.) Thick Cardboard Insert

8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.
9. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

10. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
11. Remove the throttle control grip from the end of the handlebar.
12. Pull the crimped inserts at the end of the throttle and idle control cable housings from the lower switch housing. For best results, use a rocking motion while pulling. Place a drop of light oil on the retaining rings, if necessary. Remove the cables from the switch housing.
13. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**

1. Route the loose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.
2. Route wire harness around steering head.
3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.
4. Install internal seal and locking wedge.

5. Mate connector [22] halves.
6. Assemble the switch housing. With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

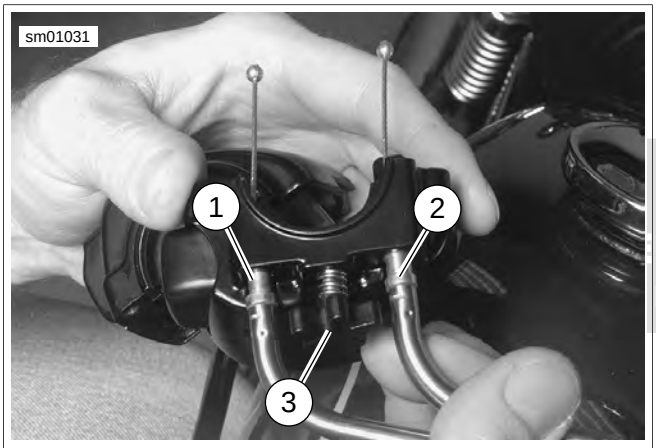
NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

7. See Figure 7-51. Push the throttle and idle control cables into the lower switch housing until they snap in place. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.
 a. Push the silver insert of throttle cable housing into the hole in front of tension adjuster screw (3).
 b. Push the gold insert (1) of idle cable housing into the hole at the rear of tension adjuster screw.

NOTE

To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.



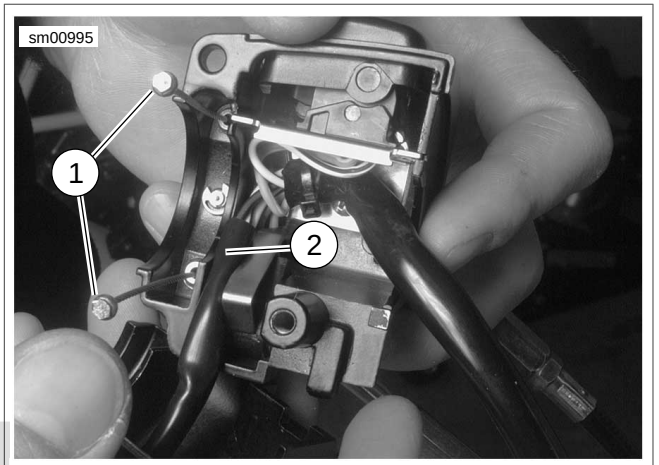
1. **Idle cable insert (gold insert, rear hole)**
2. **Throttle cable insert (silver insert, front hole)**
3. **Tension adjuster screw**

Figure 7-51. Right Lower Switch Housing

8. See Figure 7-52. Route the cable to the upper switch housing as shown.
9. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 3.2 mm (1/8 in.).
10. See Figure 7-53. Position lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.
11. Position the upper switch housing over the handlebar and lower switch housing.
12. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
13. Start the upper and lower switch housing screws, but do not tighten.

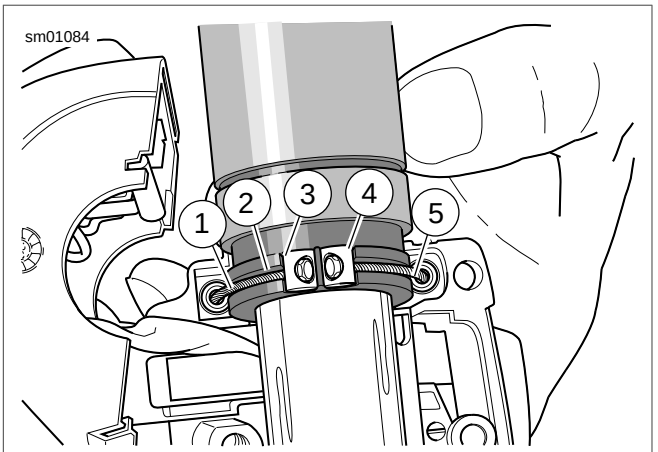
NOTICE

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)



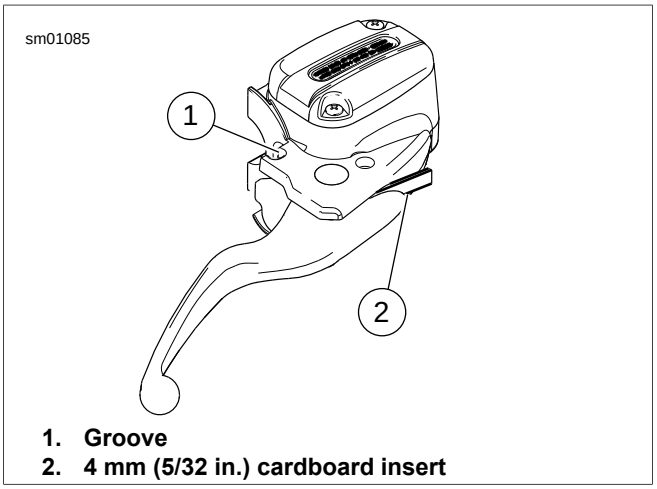
1. **End fittings**
2. **Upper switch housing cable**

Figure 7-52. Route Cable to Upper Switch Housing



1. **Throttle cable (silver insert, front hole)**
2. **Groove in throttle grip**
3. **Notch**
4. **Brass ferrule**
5. **Idle cable (gold insert, rear hole)**

Figure 7-53. Throttle Cable Installation



1. **Groove**
2. **4 mm (5/32 in.) cardboard insert**

Figure 7-54. Leave Cardboard Insert in Place

14. See Figure 7-55. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.
15. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten to 6.8-9.0 Nm (60-80 **in-lbs**).
16. Tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs**).

NOTE

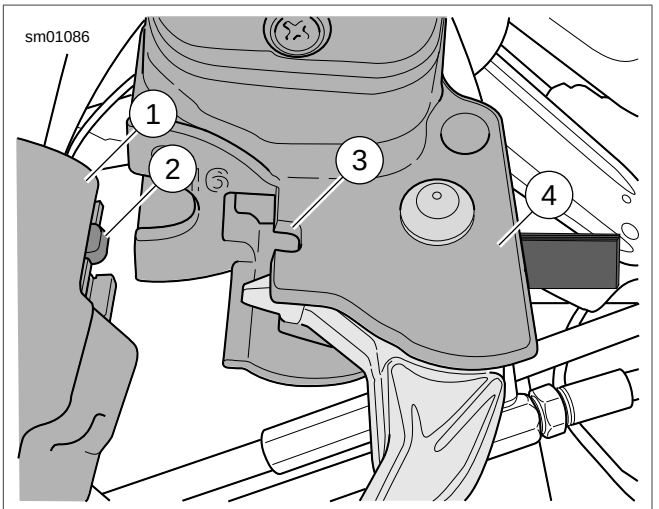
Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

17. Remove the cardboard insert between the brake lever and lever bracket.
18. Replace the main fuse. Replace the right side cover.
19. Replace the left side cover.

⚠WARNING

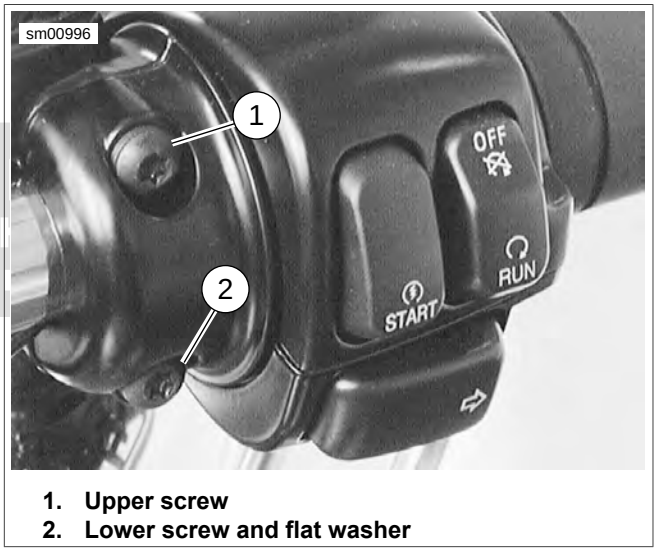
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

20. Test the switches for proper operation.



1. **Switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

Figure 7-55. Switch Housing Alignment (typical)



1. **Upper screw**
2. **Lower screw and flat washer**

Figure 7-56. Handlebar Clamp Screws (typical)

DISASSEMBLY

NOTICE

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

1. Place the cardboard insert between the brake lever and lever bracket.
2. Remove the upper and lower switch housing screws.
3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.

4. See Figure 7-56. Loosen the upper screw (1) securing the handlebar switch clamp to the master cylinder housing. Remove the lower clamp screw with flat washer (2).
5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

7. Remove the throttle control grip from the end of the handlebar.

SWITCH REPAIR/REPLACEMENT

Switch and Lead Replacement

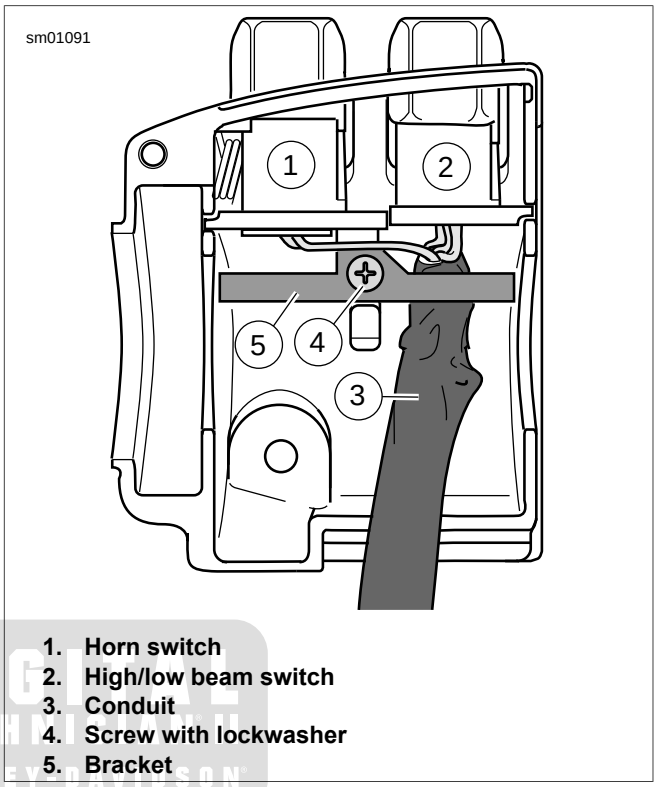
After cutting off the connector terminals, the leads of faulty switches can be pulled through the conduit. Replacement switch leads can be routed through the conduit and terminated at the connector. If necessary, only the switches can be replaced.

Switch Only Replacement: Upper Housing

NOTE

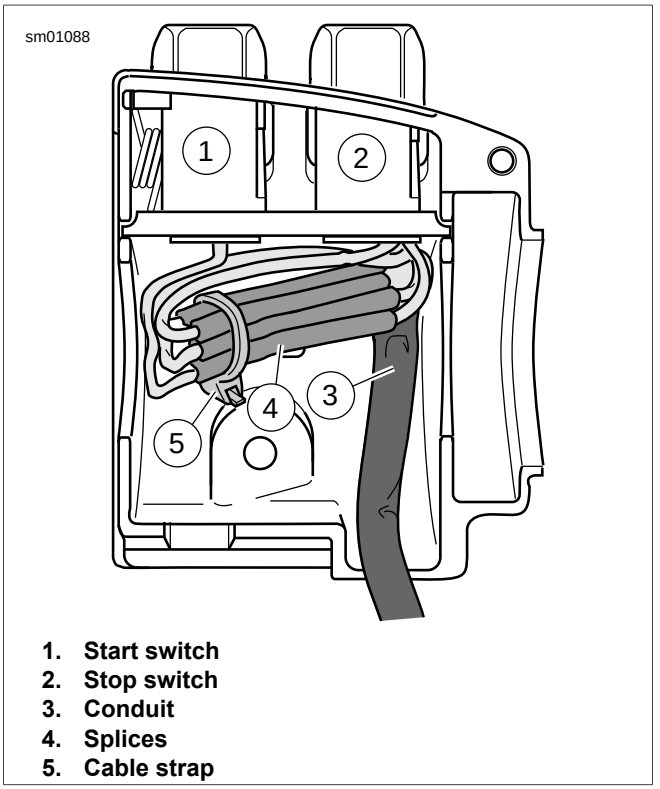
Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

1. See Figure 7-57. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove the bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 6.4 mm (0.25 in) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in) of conduit (3) material. Push conduit back to access switch wires.
4. See Figure 7-58. Separate **new** engine stop switch (2) and engine start switch (1) wires into two bundles.
5. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. See Figure 7-58. Loop switch wires and bundle splices.
7. See Figure 7-57. Route wires downstream of splices beneath wing on engine stop switch side of bracket.
8. See Figure 7-58. Install a **new**177.8 mm (7.0 in) cable strap (5) beneath wing on engine start switch side (1) of bracket and capture wire splices (4).
9. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
10. See Figure 7-57. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on engine stop switch (2) side of bracket captures edge of conduit (3) as shown.
11. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
12. Continue with 7.29 RIGHT HANDLEBAR SWITCH, Assembly.



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

Figure 7-57. Upper Housing Without Splices



1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 7-58. Upper Housing With Splices

Switch Only Replacement: Lower Housing

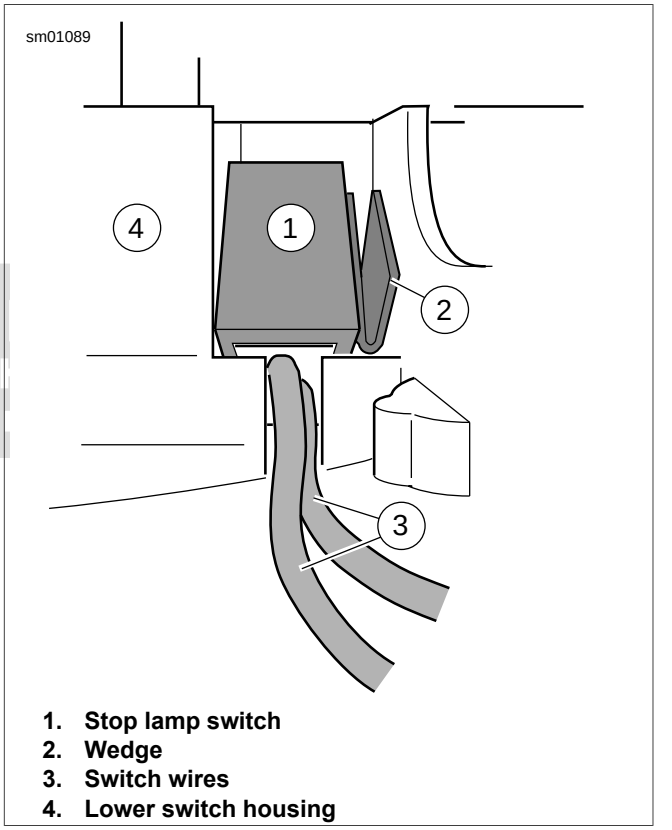
1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove the screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with procedures which follow.

Turn-Right Signal Switch Only

1. Cut wire 38.1 mm (1.5 in) from old switch. Discard old switch assembly.
2. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with 7.29 RIGHT HANDLEBAR SWITCH, Assembly.

Front Stop Lamp Switch Only

1. Carefully remove the wedge between the switch and switch housing, if present. To remove the switch from the housing, press the plunger and slowly rotate switch upward while rocking slightly.
2. Cut wires 25.4 mm (1.0 in) from old switch. Discard old switch.
3. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
4. Carefully press plunger against inside wall of switch housing. With thumb over plunger bore, move switch into the installed position in the switch housing cavity. When plunger is positioned against thumb, slowly rotate switch downward while rocking slightly. Release the plunger only after switch is properly positioned in the cavity.
5. Verify that the plunger is square in the bore and that the boot is not compressed, collapsed or torn. If necessary, gently work the plunger in and out until boot is fully extended.
6. See Figure 7-59. Push down on switch (1) so that it bottoms against housing and wires (3) run in groove at base of cavity. With the concave side facing outward, insert wedge (2) between switch and outboard side of switch housing.
7. Push wedge down until it also bottoms against housing. Verify that the plunger is still square in the bore and then place a drop of RTV Silicone Sealant on upper corner of wedge.
8. Continue with 7.29 RIGHT HANDLEBAR SWITCH, Assembly.



1. **Stop lamp switch**
2. **Wedge**
3. **Switch wires**
4. **Lower switch housing**

Figure 7-59. Install Stop Lamp Switch

ASSEMBLY

1. See Figure 7-60. Insert tapered end of **new** 177.8 mm (7.0 in) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated.

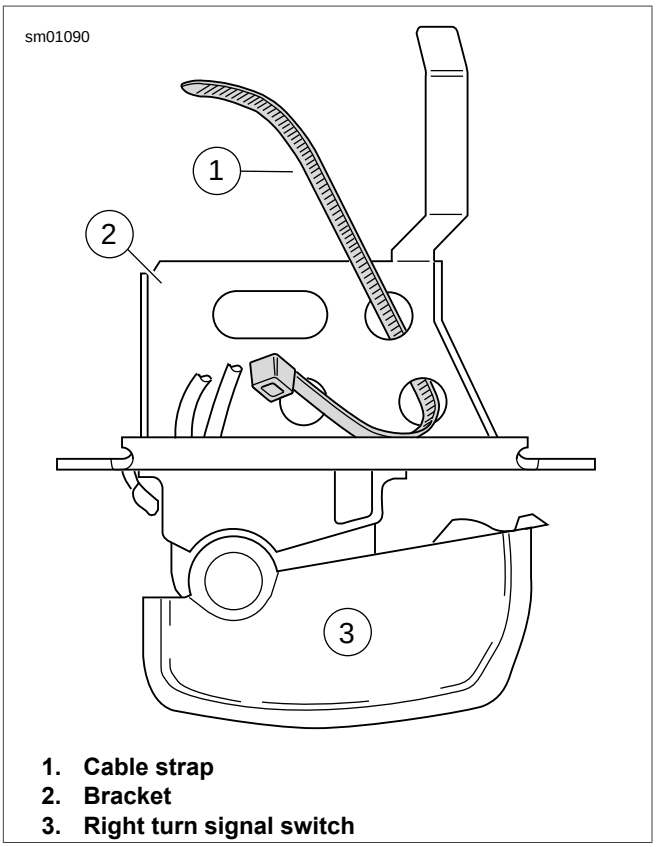
Tabs on each side of bracket are captured in slots cast into switch housing.

3. Start screw with lockwasher to secure bracket inside housing.

NOTICE

If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 6.4 mm (0.25 in) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Install second 177.8 mm (7.0 in) cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.
7. Tighten screw to secure bracket inside housing.
8. Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure front stoplight switch in position.
9. See 7.29 RIGHT HANDLEBAR SWITCH, Installation.
 a. If lower housing switches were replaced, perform the entire procedure.
 b. If upper housing switches were replaced, begin with step 11.



1. **Cable strap**
2. **Bracket**
3. **Right turn signal switch**

Figure 7-60. Insert Cable Strap in Switch Bracket

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

LEFT HANDLEBAR SWITCH 7.30

REMOVAL

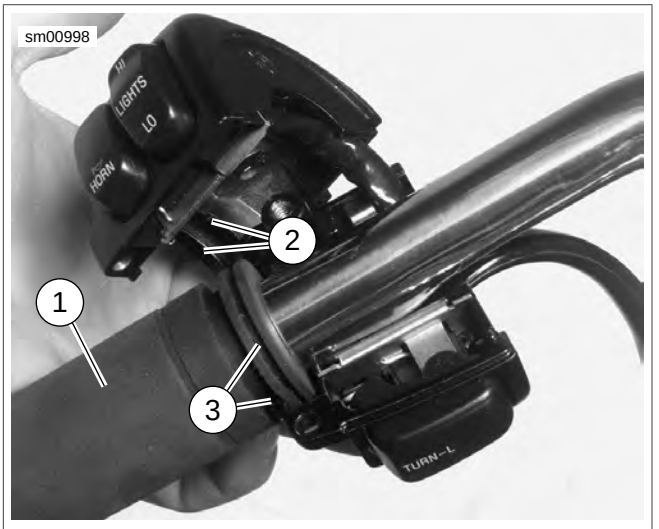
NOTE

The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.

1. Remove main fuse. See 7.6 MAIN FUSE.
2. See Figure 7-61. If removing the switch housing and wire harness, remove the left side cover and locate the left switch housing connector [24].
3. Press latch on the socket housing and separate the switch housing connector halves.
4. Remove secondary locking wedge and press terminal latches inside socket housing to remove socket terminals and wires.
5. Remove the two screws with flat washers securing the handlebar clamp to the clutch lever and master cylinder bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
6. Remove the upper and lower switch housing screws.
7. Remove the grip sleeve from the end of the handlebar if damaged.
8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.
9. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

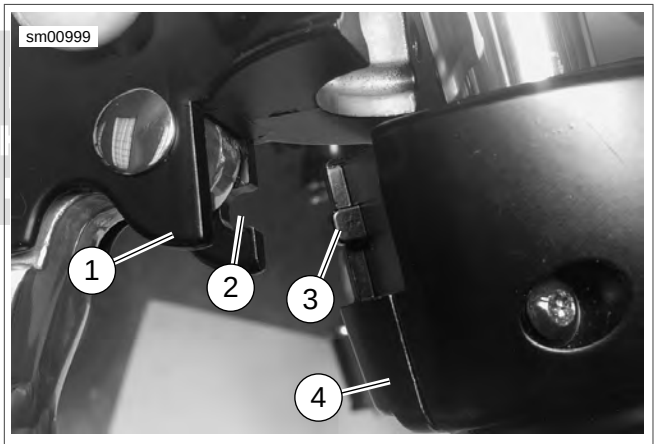


Figure 7-61. Left Switch Housing Connector [24] (typical)



1. **Grip sleeve**
2. **Ribs**
3. **Grooves**

Figure 7-62. Left Handlebar Switch Housings



1. **Clutch lever bracket**
2. **Groove**
3. **Tab**
4. **Switch housing assembly**

Figure 7-63. Clutch Lever Bracket

INSTALLATION

FASTENER	TORQUE VALUE	
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**

1. Thread the lose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.
2. Route wire harness around steering head.

3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.
4. Install internal seal and locking wedge.
5. Mate connector [24] halves.
6. the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue. Pour adhesive into **new** grip. Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.
7. See Figure 7-62. Install upper and lower switch housings on handlebar. Be sure that ribs (2) on outboard side of switch housings fit in grooves (3) molded into grip.
8. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
9. Start the upper and lower switch housing screws, but do not tighten.
10. See Figure 7-63. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab (3) on the lower switch housing in the groove (2) at the bottom of the clutch lever bracket.
11. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten screws to 6.8-9.0 Nm (60-80 **in-lbs**).
12. Tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs**).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

13. Replace the main fuse. and the right side cover.
14. Replace the left side cover.
15. Test the switches for proper operation.

DISASSEMBLY

1. Remove the upper and lower switch housing screws.
2. If replacing lower housing switches, perform next step before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
3. Loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

SWITCH REPAIR AND REPLACEMENT

Switch and Lead Replacement

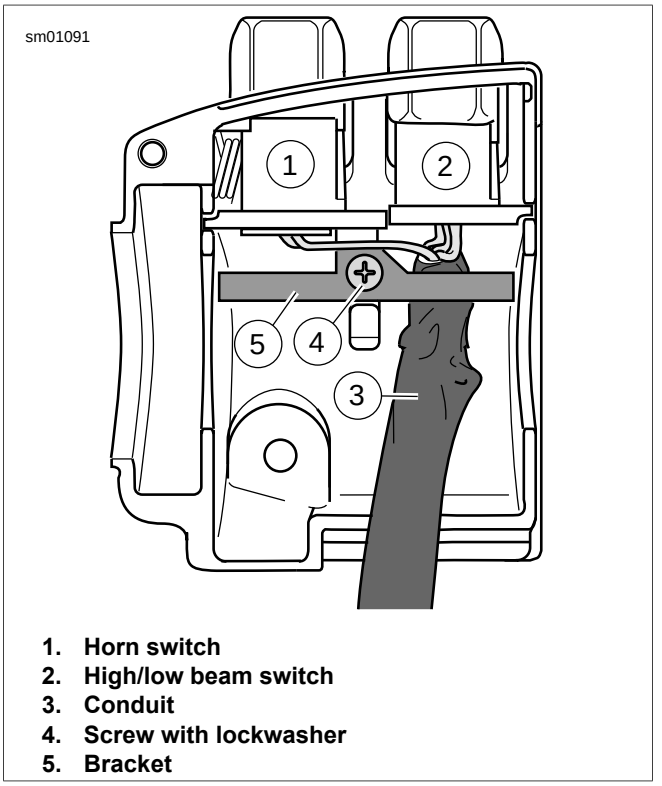
After cutting off the connector terminals, the leads of faulty switches can be pulled through the conduit. Replacement switch leads can be routed through the conduit and terminated at the connector. If necessary, only the switches can be replaced.

Switch Only Replacement: Upper Housing

NOTE

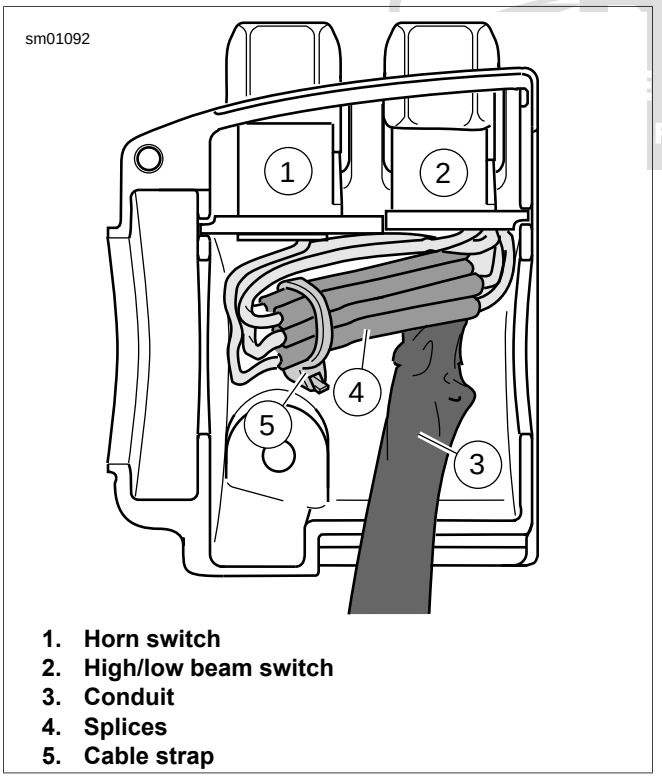
Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.

1. See Figure 7-64. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 6.4 mm (0.25 in) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in) of conduit (3) material. Push conduit back to access switch wires.
4. Separate the **new** horn switch (1) and high/low beam switch (2) wires into two bundles.
5. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 7-65. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as shown in Figure 7-64.
7. See Figure 7-65. Install a **new** 177.8 mm (7.0 in) cable strap (5) beneath wing on horn switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See Figure 7-64. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on high/low switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with 7.30 LEFT HANDLEBAR SWITCH, Assembly.



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

Figure 7-64. Upper Housing Without Splices



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 7-65. Upper Housing With Splices

Switch Only Replacement: Lower Housing

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with procedures that follow.

Turn-Left Signal Switch Only

1. Cut wires 38.1 mm (1.5 in) from old turn signal switch. Discard switch assembly.
2. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with 7.30 LEFT HANDLEBAR SWITCH, Assembly.

Clutch Interlock Switch Only

1. See Figure 7-66. Cut wires 6.4 mm (0.25 in) from old switch. Discard switch assembly.
2. See 7.28 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with 7.30 LEFT HANDLEBAR SWITCH, Assembly.

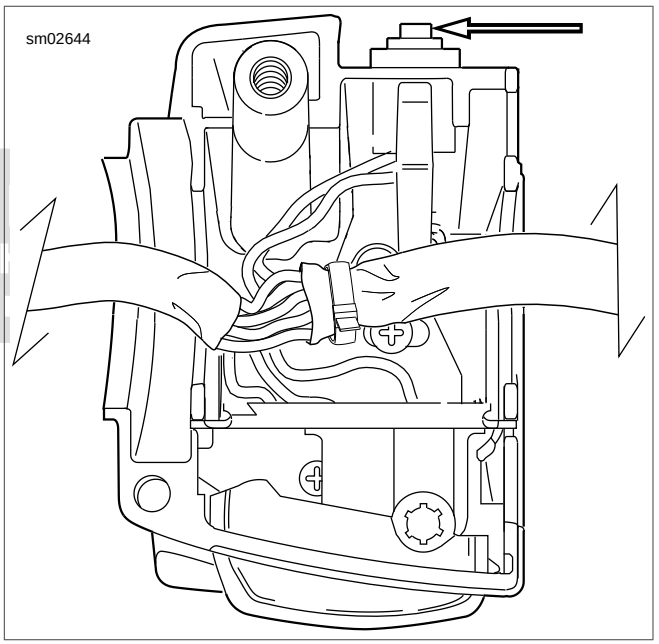


Figure 7-66. Clutch Interlock Switch

ASSEMBLY

1. See Figure 7-67. Insert tapered end of **new** 177.8 mm (7.0 in) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

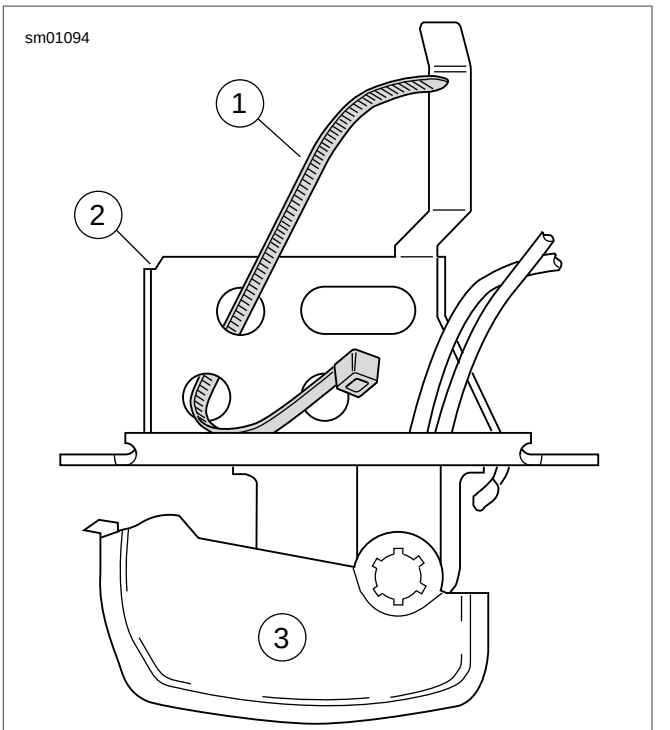
2. Place the turn signal switch assembly (3) into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.

3. Start screw with lockwasher to secure bracket inside housing.

NOTICE

If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 6.4 mm (0.25 in) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten screw to secure bracket inside housing.
7. Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to arm using **new** cable strap. Cut any excess cable strap material.
8. See 7.30 LEFT HANDLEBAR SWITCH, Installation.
 a. If lower housing switches were replaced, perform the whole procedure.
 b. If upper housing switches were replaced, begin with step 7.
9. Verify the operation of the clutch interlock switch. See the electrical diagnostic manual.



1. **Cable strap**
2. **Bracket**
3. **Left turn signal switch**

Figure 7-67. Insert Cable Strap in Switch Bracket

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

HFSM MAINTENANCE 7.31

GENERAL

The TSSM and HFSM use batteries in the fob and siren. These are the only parts requiring periodic maintenance.

FOB BATTERY

Battery Replacement Schedule

Replace the fob battery every year.

Battery Replacement

1. Open the fob case.
 a. See Figure 7-68. Place a thin blade in the thumbnail slot (1) between the two halves of the case.
 b. Slowly twist the blade.
2. Replace the battery.
 a. Remove the original battery.
 b. Install a **new** battery with the positive (+) side down. Use a Panasonic® 2032 or equivalent.
3. Close the case.
 a. See Figure 7-68. With O-ring (3) in place, align case halves.
 b. Snap case halves together.



1. **Thumbnail slot**
2. **Battery (Panasonic 2032)**
3. **O-ring**

Figure 7-68. Open Fob: HFSM

SMART SIREN (IF INSTALLED)

Battery Replacement Schedule

The siren's internal 9V battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTE

The internal siren battery may not charge if the motorcycle's battery is less than 12.5V.

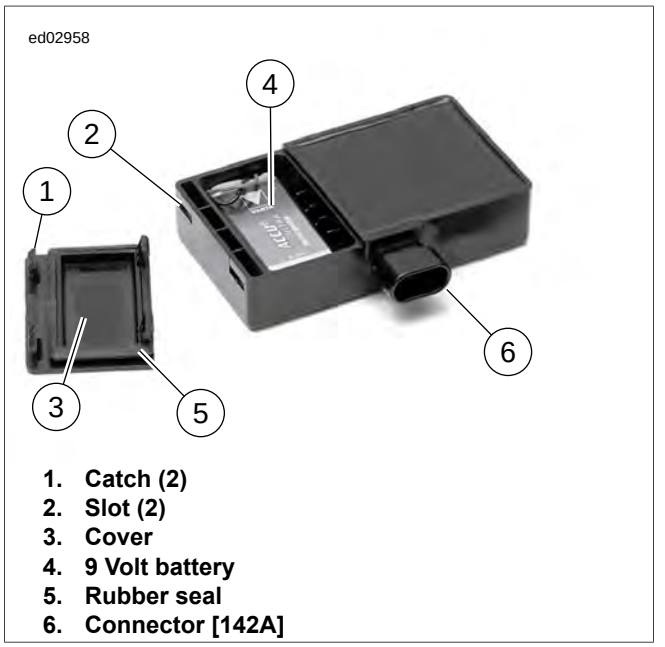
Battery Replacement

1. Disarm system and remove siren.
2. See Figure 7-69. With a small screwdriver or pick, push the catches (1) in through the two slots (2) in the end of the siren to release the battery cover (3).

NOTES

- *For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on **new** battery.*
- *Only a 9V nickel metal hydride battery should be used in the siren.*

3. Replace battery (4) by removing old battery from polarized battery clip.
4. Recharge and install or install a **new** 9V nickel metal hydride battery.
5. Install battery cover (3).
 a. Carefully replace the rubber seal (5) on the cover.
 b. Align battery cover with case placing round corners on cover away from connector [142A] (6).
 c. Snap cover into place.
6. Install siren and check operation. If siren is working properly, it responds with two chirps after receiving the arm command.



1. Catch (2)
2. Slot (2)
3. Cover
4. 9 Volt battery
5. Rubber seal
6. Connector [142A]

Figure 7-69. Battery Compartment

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

PERSONAL IDENTIFICATION NUMBER (PIN) 7.32

GENERAL

The PIN consists of five digits. Each digit can be any number from 1 through 9. There can be no zeros (0) in the PIN. Use the PIN to disarm the security system in case the fob becomes unavailable.

INITIAL PIN ENTRY

To enter a PIN on a motorcycle with no PIN previously installed during HFSM actuation, refer to Table 7-6.

Table 7-6. Entering an Initial PIN: HFSM, TSSM

STEP	ACTION	CONFIRMATION
1	Select a five-digit (1 through 9) initial PIN and record in the owner's manual and on the wallet card.	
2	With an assigned fob present, set engine stop switch to **OFF.**	
3	Cycle ignition switch **IGNITION**-OFF-**IGNITION**-OFF-**IGNITION.**	
4	Press **left** turn signal button twice.	Turn signals flash three times.
5	Press **right** turn signal button once.	Five dashes appear in the odometer window. The first dash flashes.
6	Enter first digit (a) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
7	Press **right** turn signal button once.	The digit (a) replaces the dash in the odometer. The second dash flashes.
8	Enter second digit (b) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
9	Press **right** turn signal button once.	The digit (b) replaces the dash in the odometer. The third dash flashes.
10	Enter third digit (c) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
11	Press **right** turn signal button once.	The digit (c) replaces the dash in the odometer. The fourth dash flashes.
12	Enter fourth digit (d) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
13	Press **right** turn signal button once.	The digit (d) replaces the dash in the odometer. The fifth dash flashes.
14	Enter fifth digit (e) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
15	Press **right** turn signal button once.	The digit (e) replaces the dash in the odometer. The first digit flashes.
16	Turn the ignition switch to **OFF.**	

CHANGING THE PIN

To change a PIN, refer to Table 7-7. The rider can change the PIN at any time.

Modifying an Existing Pin

If a PIN was previously entered, the odometer will display the equivalent digit. Each additional press of the left turn switch will increment the digit.

Examples:

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

Table 7-7. Changing the PIN: HFSM

STEP	ACTION	CONFIRMATION	NOTES
1	Select a five-digit (1 through 9) PIN and record in the owner's manual and on the wallet card.		
2	With fobs present, cycle ignition switch IGNITION-OFF-IGNITION-OFF-IGNITION.		
3	Press **left** turn signal button twice.	Turn signals flash 3 times.	
4	Press **right** turn signal button once.	Current PIN will appear in odometer. The first digit will flash.	
5	Enter first digit (a) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
6	Press **right** turn signal button once.	The new digit replaces the current in the odometer. The second digit flashes.	
7	Enter second digit (b) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
8	Press **right** turn signal button once.	The new digit replaces the current in the odometer. The third digit flashes.	
9	Enter third digit (c) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
10	Press **right** turn signal button once.	The new digit replaces the dash in the odometer. The fourth digit flashes.	
11	Enter fourth digit (d) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
12	Press **right** turn signal button once.	The new digit replaces the current in the odometer. The fifth digit flashes.	
13	Enter fifth digit (e) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
14	Press **right** turn signal button once.	The new digit replaces the current in the odometer. The first digit flashes.	
15	Turn the ignition switch to **OFF.**		Turning ignition switch to OFF stores PIN.

DIGITAL TECHNICIAN II

H-DSSS ACTUATION 7.33

GENERAL

Setting up a vehicle TSM/HFSM depends on whether the vehicle has a TSM or the optional HFSM security system installed.

SIDECAR CONFIGURATION

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

All motorcycles ship with the H-DSSS set for use **without** a sidecar installed. If a motorcycle is equipped with a TSM, no further actuation is required.

ACTUATION

Actuation consists of assigning two fobs to the system, and entering an initial PIN. The PIN can be changed by the rider at any time.

1. Configure vehicles by assigning **both** fobs to the vehicle.
2. Configure vehicles by entering a PIN picked by the owner. The personal code allows the owner to operate the system if the fob is lost or inoperable. Record the PIN in the owner's manual. Instruct the customer to carry a copy (use the wallet card found in the owner's manual). See 7.32 PERSONAL IDENTIFICATION NUMBER (PIN).

Once the system has been activated, it will always "arm" within 5 seconds of turning the ignition switch to **OFF** or **ACC** and no motorcycle motion.

FOB ASSIGNMENT

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Use DIGITAL TECHNICIAN II (Part No. HD-48650) to assign both fobs to the H-DSSS. Follow the menu prompts in the DIGITAL TECHNICIAN II (Part No. HD-48650) display and scan the fob serial number with the bar code reader, or key-in the number from the keyboard. The initial PIN entry should be performed using DIGITAL TECHNICIAN II (Part No. HD-48650) in conjunction with fob assignment. See a Harley-Davidson dealer.

NOTE

Each fob has a unique serial number. Attach label from fob to a blank NOTES page in the owner's manual for reference.

POWER DISRUPTION AND CONFIGURING

Removing battery voltage from the TSM/HFSM module can happen because of any of the following:

- Battery disconnect
- Power drain
- Battery fuse removal
- Connecting a breakout box to the TSM/HFSM connector

After battery voltage has been removed from terminal 1 of the TSM/HFSM, the module will not enter the PIN entry mode on the first attempt. Initialize the PIN entry configuration sequence twice before entering the PIN:

1. Set engine OFF/RUN switch to **OFF**.
2. Cycle the ignition switch:
 a. IGNITION
 b. OFF
 c. IGNITION
 d. OFF
 e. IGNITION
3. Press the left turn signal switch **twice**.
4. Repeat steps listed above.
5. Continue with the PIN entry sequence.

TSM/HFSM: PASSWORD LEARN 7.34

GENERAL

If the ECM or TSM/HFSM is faulty, replace the unit. See 7.3 ELECTRONIC CONTROL MODULE (ECM) or 7.4 TURN SIGNAL AND SECURITY MODULE (TSM/TSSM/HFSM). Then, to determine if password learn is necessary, refer to Table 7-8.

Table 7-8. Password Learn

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
TSM	No *
TSM/HFSM	Yes
* If a TSM has been replaced by a HFSM, or a HFSM has been replaced by a TSM, password learn is necessary.	

PASSWORD LEARN

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To perform the password learn procedure, refer to Table 7-9. When finished, continue with all instructions under 7.33 H-DSSS ACTUATION.

TSM/HFSM: Always perform all appropriate instructions under 7.33 H-DSSS ACTUATION after TSM/HFSM replacement or removal.

TSM/TSSM (Japan/Korea markets): Always perform all appropriate instructions under VEHICLE DELIVERY in the electrical diagnostic manual after TSM/TSSM replacement or removal.

NOTES

- ***HFSM:*** *Fob assignment must be performed at an authorized Harley-Davidson dealer using DIGITAL TECHNICIAN II (Part No. HD-48650).*
- ***TSSM:*** *Do not forget to enter a Personal Identification Number (PIN) for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.*

Table 7-9. Setting TSM/TSSM/HFSM and ECM Password

NO.	ACTION	CONFIRMATION	NOTES
	Ignition must be turned off for at least 15 seconds.	With Ignition Switch turned off, Check Engine lamp and Security lamp will be off.	
1	Install **new** TSM/TSSM/HFSM or ECM.		
2	Set Engine Stop Switch to **RUN.**		
3	Turn Ignition Switch **ON.**	Verify Check Engine lamp and Security lamp illuminate and then turn off.	TSM/HFSM enables start relay.
4	Attempt normal start one time.	Engine starts and stalls. Check Engine lamp illuminates and stays on.	Password has not been learned. ECM sets DTC P1009.
5	Wait ten seconds. Security lamp will illuminate and stay on.	Security lamp illuminates.	ECM enters Password Learning mode for ten minutes. Do not cycle Ignition Switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until Security lamp turns off.		This takes ten minutes.
7	Quickly (within two seconds) turn Ignition Switch OFF-**ON.**		ECM must not be allowed to shutdown.
8	Wait until Security lamp turns off.		This takes ten minutes.
9	Quickly (within two seconds) turn Ignition Switch OFF-**ON.**		ECM must not be allowed to shutdown.
10	Wait until Security lamp turns off.		This takes ten minutes.
11	Quickly (within two seconds) turn Ignition Switch OFF-**ON.**		ECM must not be allowed to shutdown.

Table 7-9. Setting TSM/TSSM/HFSM and ECM Password

NO.	ACTION	CONFIRMATION	NOTES
12	Turn Ignition Switch **OFF**. Wait 15 seconds before turning Ignition Switch on. Turn Ignition Switch **ON** and start engine to confirm successful Password Learn procedure. Clear DTCs.		
13	**TSM/HFSM:** Perform all steps under 7.33 H-DSSS ACTUATION. **TSM/TSSM (Japan/Korea markets):** Perform all steps under VEHICLE DELIVERY in electrical diagnostic manual.		

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

NOTES

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

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DIGITAL TECHNICIAN II HARLEY-DAVIDSON

NOTES

AUTOFUSE UNSEALED ELECTRICAL CONNECTORS A.1

AUTOFUSE UNSEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
GA500A	SNAP-ON TERMINAL PICK

General

Autofuse Unsealed connector terminals are found in ignition switches and some fuse blocks.

Disassembly

1. See Figure A-1 or Figure A-2. Insert smallest pair of pins on the SNAP-ON TERMINAL PICK (Part No. GA500A) into chamber on mating end of socket housing to press tangs on each side of terminal simultaneously.
2. Gently pull on wire to remove terminal from wire end of socket housing.
3. If necessary, crimp **new** terminals on wires.

Assembly

1. Carefully bend tang on each side of terminal outward away from terminal body. Use the thin flat blade from a hobby knife.
2. With the open side of the terminal facing rib on wire end of socket housing, insert terminal into chamber until it locks in place.

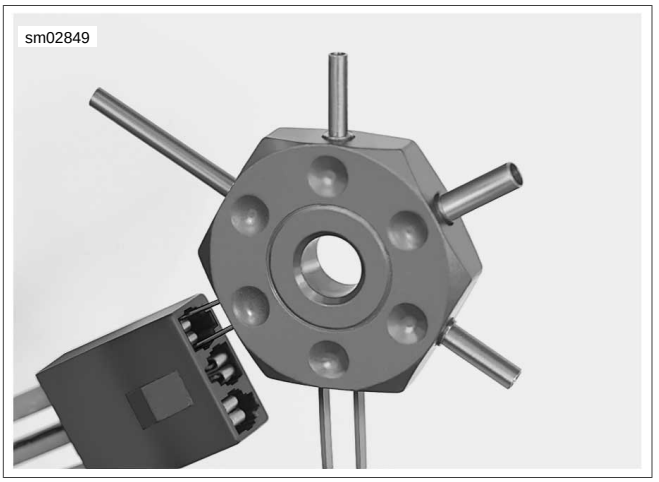


Figure A-1. Removing Autofuse Unsealed Terminal from Ignition Switch

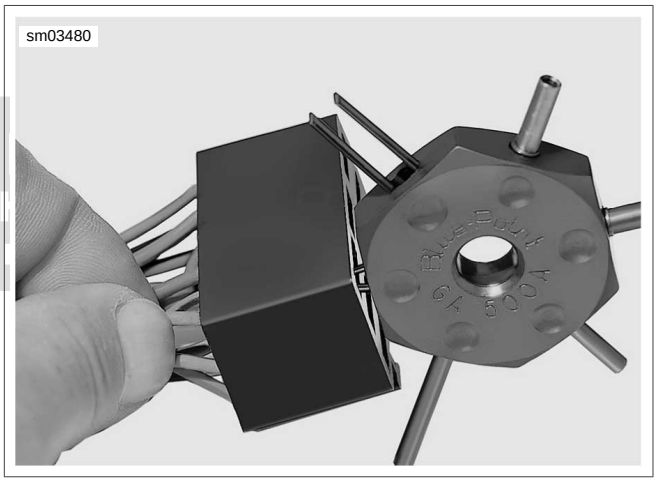


Figure A-2. Removing Autofuse Unsealed Terminal from Fuse Block

DELPHI 100W MICRO-PACK SEALED CONNECTOR A.2

DELPHI 100W MICRO-PACK SEALED CONNECTOR REPAIR

General

A Delphi 100W Micro-Pack Sealed connector connects the electronic control module (ECM) to the main harness.

NOTE

For vehicles with 73-pin connectors, see A.9 DELPHI MICRO 64 SEALED CONNECTORS and A.8 DELPHI METRI-PACK TERMINAL REPAIR.

Separating Socket Housing From ECM

See Figure A-3. While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

Mating Socket Housing To ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.

Removing Socket Terminal

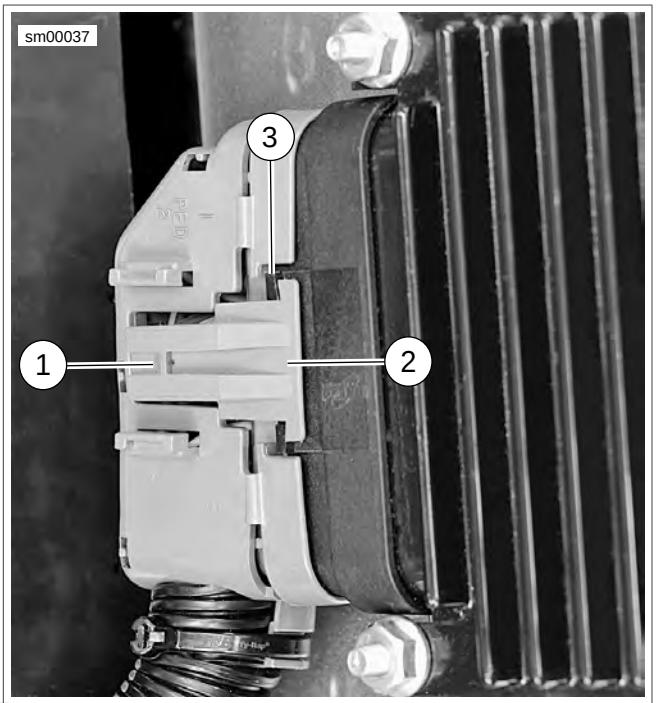
1. See Figure A-4. Gently press latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See Figure A-5. Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

Installing Socket Terminal

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

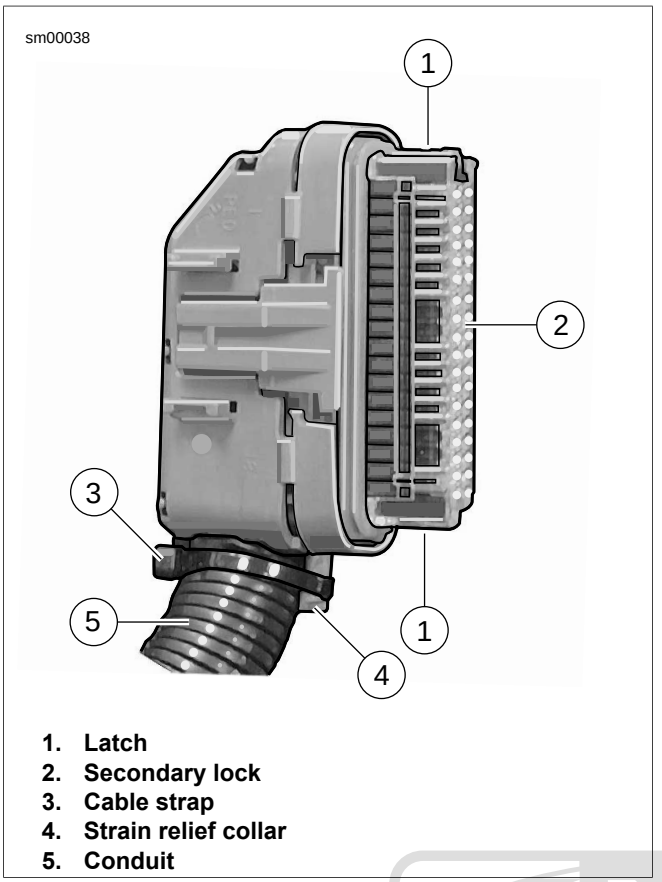
Crimping Terminals

If necessary, crimp **new** terminals on wire leads. See A.8 DELPHI METRI-PACK TERMINAL REPAIR.



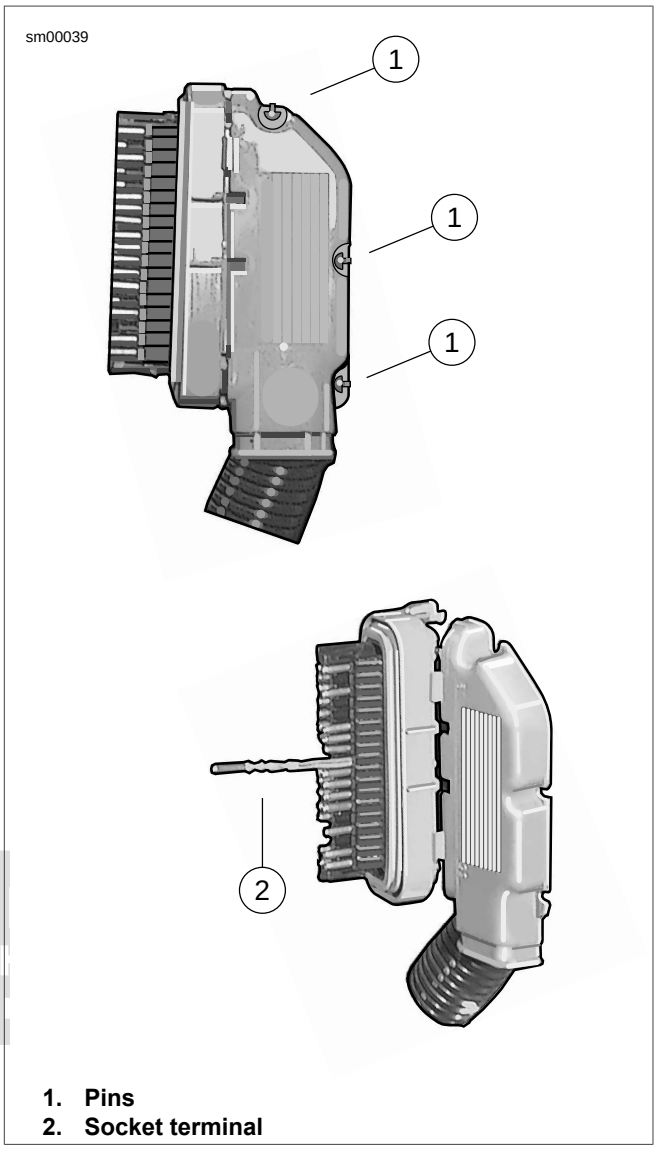
1. **Thumb lever**
2. **Latch**
3. **Catch (ECM)**

Figure A-3. Delphi 100W Micro-Pack Sealed Connector to ECM (typical)



1. Latch
2. Secondary lock
3. Cable strap
4. Strain relief collar
5. Conduit

Figure A-4. Delphi 100W Micro-Pack Sealed Connector



1. Pins
2. Socket terminal

Figure A-5. Delpi 100W Micro-Pack Sealed Connector: Separate Halves of Socket Housing

DELPHI 150 METRI-PACK SEALED CONNECTORS A.3

DELPHI 150 METRI-PACK SEALED CONNECTOR REPAIR

General

Delphi 150 Metri-Pack Sealed connectors are embossed with the initials (P.E.D.).

There are two types of connectors in this series:

- Pull-to-Seat
- Push-to-Seat

Separating Pin and Socket Housings

Bend back the external latch slightly and separate the pin and socket halves of the connector.

Mating Pin and Socket Housings

Align the wire colors and push the pin and socket halves of the connector together.

Removing Socket Terminal

1. See Figure A-6 for pull-to-seat connector or Figure A-7 for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

For best results, free one side of wire lock first and then release the other side.

2. Find the locking tang in the mating end of the connector.

NOTE

The tangs are always positioned in the middle of the chamber. The tangs are on the same side as the external latch.

3. Gently insert a small diameter straight pin into the chamber about 3.2 mm (1/8 in).
 a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
 b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

NOTE

The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

NOTE

After repeated terminal extractions, the click may not be heard, but pivot the pin as if the click was heard at least three times.

6. Remove the pin.
 a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
 b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

Inserting Socket Terminal

NOTE

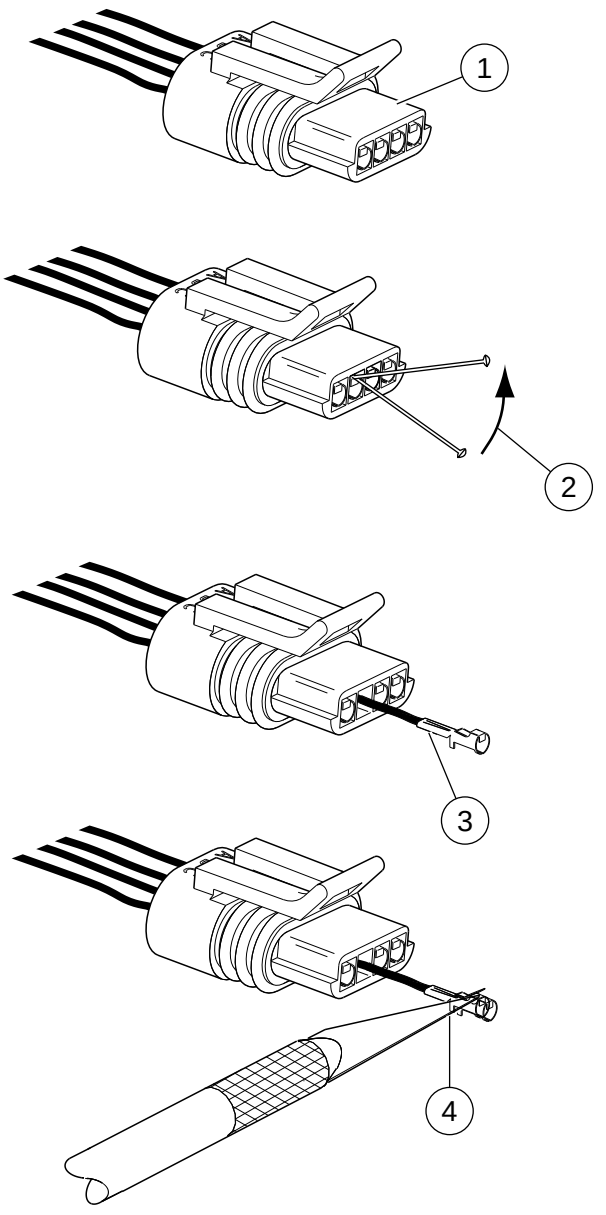
For wire location purposes, alpha characters are stamped into the socket housings.

1. See Figure A-6 for pull-to-seat connector or Figure A-7 for push to seat connector. Carefully bend tang on each side of terminal outward away from terminal body. Use the thin flat blade from a hobby knife.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

 For push-to-seat: See Figure A-7. Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

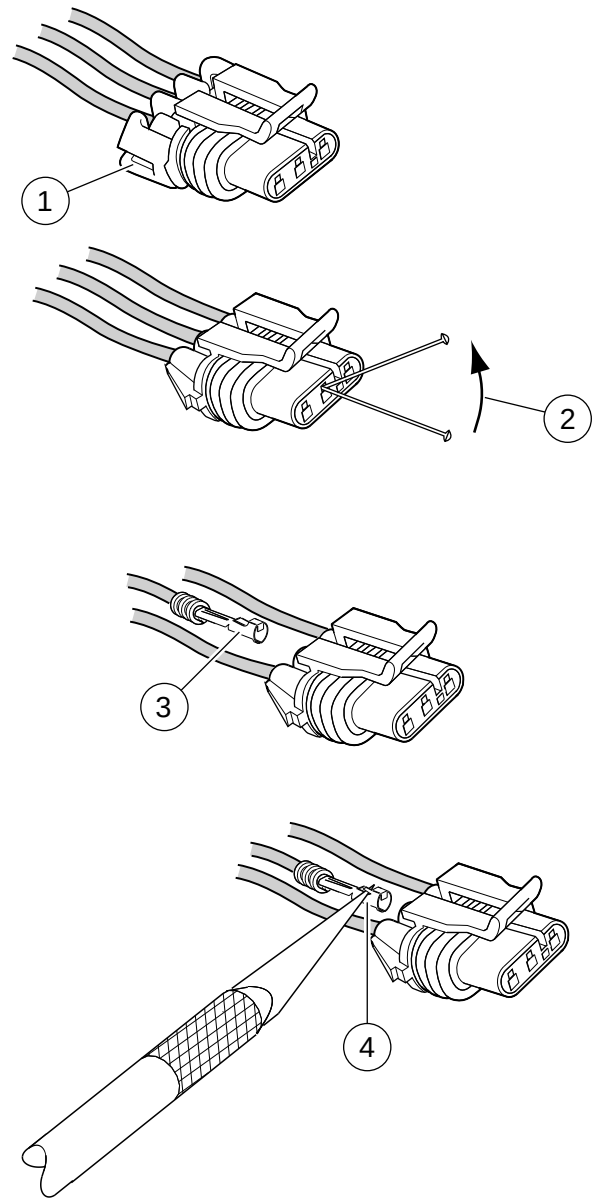
sm00027a



1. Locate tang in chamber
2. Pivot pin to release tang
3. Push to remove
4. Raise tang to install

Figure A-6. Delphi 150 Metri-Pack Sealed Connector: Pull-to-Seat

sm00028a



1. Remove wire lock
2. Pivot pin to release tang
3. Pull to remove
4. Raise tang to install

Figure A-7. Delphi 150 Metri-Pack Sealed Connector: Push-to-Seat

DELPHI 280 METRI-PACK UNSEALED CONNECTORS A.4

FUSE BLOCK REPAIR

Removing Socket Terminals

1. See Figure A-8. To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

NOTE

For best results, start with locking wedge on outboard side of secondary lock.

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Use the thin flat blade from a hobby knife. Gently push tang away from terminal and then tug on wire to back terminal out.

Installing Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

NOTES

- *Refer to the main harness wiring diagram for wire lead color codes.*
- *See Figure A-9. The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.*

2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.

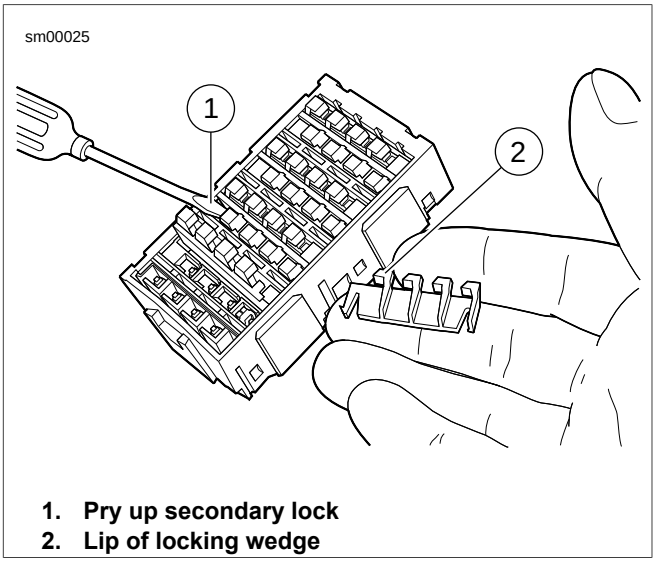
Crimping Terminals

Terminals are crimped twice: once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers.

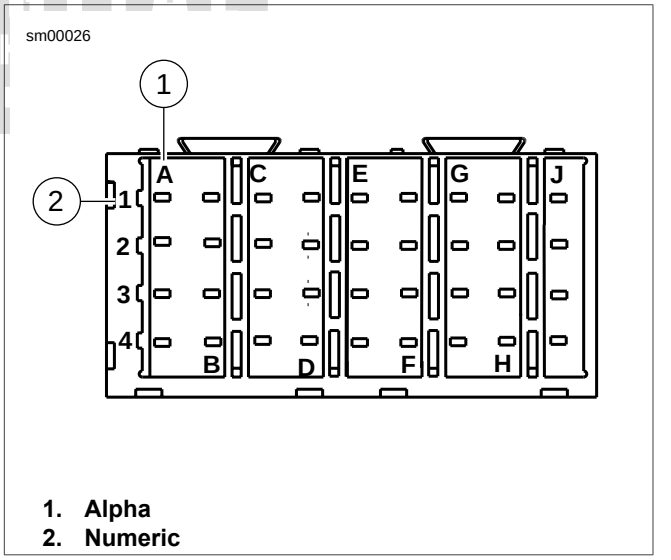
NOTE

The wiring diagram indicates when one socket terminal is be crimped to two wire leads.



1. Pry up secondary lock
2. Lip of locking wedge

Figure A-8. Fuse Block: Remove Secondary Locks



1. Alpha
2. Numeric

Figure A-9. Fuse Block: Coordinates (typical)

DELPHI 480 METRI-PACK UNSEALED CONNECTORS A.5

DELPHI 480 METRI-PACK UNSEALED CONNECTOR REPAIR

General

A 480 Metri-Pack connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

See Figure A-10. An AFL housing (5) is used on many ignition/light switches. The secondary lock (4) must be opened before removing the terminal from the housing.

Separating Pin and Socket Housings

NOTES

- *Record position of cable straps anchoring wire conduits of the pin and socket housing before removing them.*
- *Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.*

See Figure A-10. Using small flat blade screwdriver, press button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

Mating Pin and Socket Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

Removing Socket Terminals

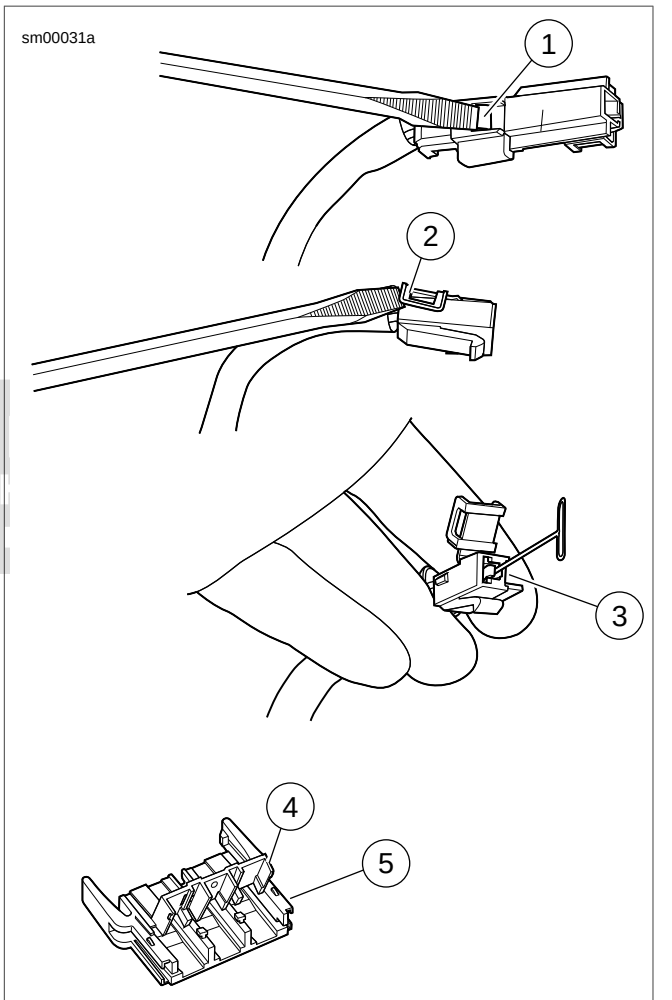
1. See Figure A-10. Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to press the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See A.8 DELPHI METRI-PACK TERMINAL REPAIR.

Installing Socket Terminals

1. Carefully bend the tang outward away from the terminal body.
2. With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it clicks in place.
3. Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.

NOTE

*If removed, install **new** anchored cable strap in original equipment location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 25.4 mm (1.0 in) from housings.*



1. **Button on pin housing**
2. **Secondary lock latch**
3. **Opening between tang and chamber wall**
4. **Secondary lock (shown open)**
5. **AFL housing**

Figure A-10. Delphi 480 Metri-Pack Unsealed Connector: Remove Socket Terminal

DELPHI 630 METRI-PACK UNSEALED CONNECTORS A.6

DELPHI 630 METRI-PACK UNSEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
SNAP-ON TT600-3	SNAP-ON PICK

Separating Pin and Socket Housings

NOTE

If necessary, remove connector from barbed anchor or other retaining device.

Bend back the external latch slightly and separate pin and socket halves of the connector.

Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and engages a rib in the chamber wall to lock the terminal in place.
3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to press the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to A.8 DELPHI METRI-PACK TERMINAL REPAIR.

Installing Socket Terminal

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Carefully bend tang on each side of terminal outward away from terminal body. Use the thin flat blade from a hobby knife.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

DIGITAL TECHNICIAN HARLEY-DAVIDSON®

DELPHI 800 METRI-PACK SEALED MAIN FUSE HOUSING A.7

DELPHI 800 METRI-PACK SEALED MAIN FUSE HOUSING REPAIR

Removing Socket Terminals

⚠WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

1. Disconnect battery.
2. See Figure A-11. Disengage slots (1) on secondary lock (2) from tabs (3) and remove secondary lock.
3. Insert flat blade of pick or small screwdriver into opening (4) until it stops.
4. Tug on cable to pull socket from connector housing. Pivot the pick toward the terminal body to release the latch if necessary.
5. Repeat to remove remaining socket terminal.

NOTE

The battery positive cable and power wire for the main fuse are crimped together at the starter ring terminal. Replace both as an assembly if either requires replacement.

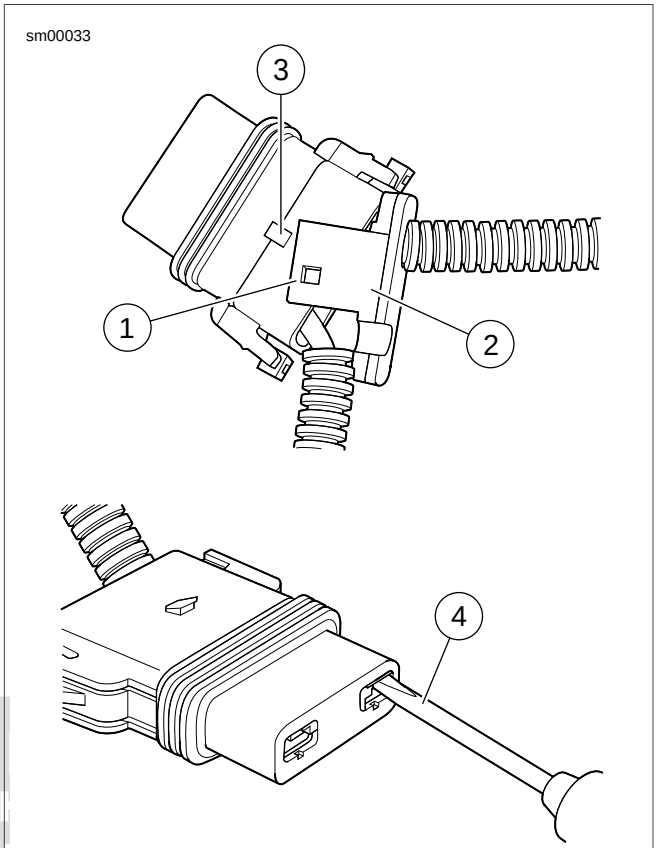
Installing Socket Terminals

1. See Figure A-12. Carefully bend tang outward away from the terminal body.
2. Properly orient terminal to the cavity in the housing and push terminal into connector housing until it clicks in place. Verify that socket will not back out of chamber.
3. Push rubber seal into connector housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto connector housing. be sure slots engage tabs on sides of connector housing.

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

6. Connect battery cables.



1. **Secondary lock slot**
2. **Secondary lock**
3. **Tab**
4. **Insert flat blade into opening**

Figure A-11. Delphi 800 Metri-Pack Sealed Main Fuse Housing: Remove Socket Terminals

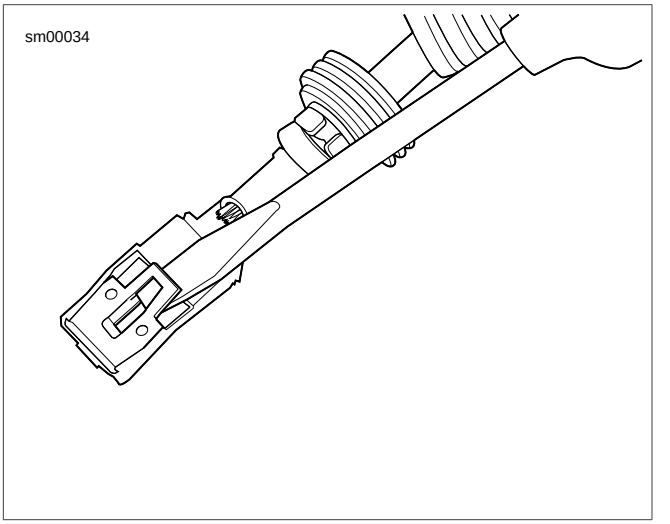


Figure A-12. Delphi 800 Metri-Pack Sealed Main Fuse Housing: Bend Tang

DELPHI METRI-PACK TERMINAL REPAIR A.8

METRI-PACK TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-6	PACKARD TERMINAL CRIMP TOOL
HD-38125-7	PACKARD TERMINAL CRIMPER
HD-38125-8	PACKARD CRIMPING TOOL

Matching Terminal To Crimper

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

See Figure A-13. A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

The PACKARD CRIMPING TOOL (Part No. HD-38125-8) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.

Preparing Wire Lead

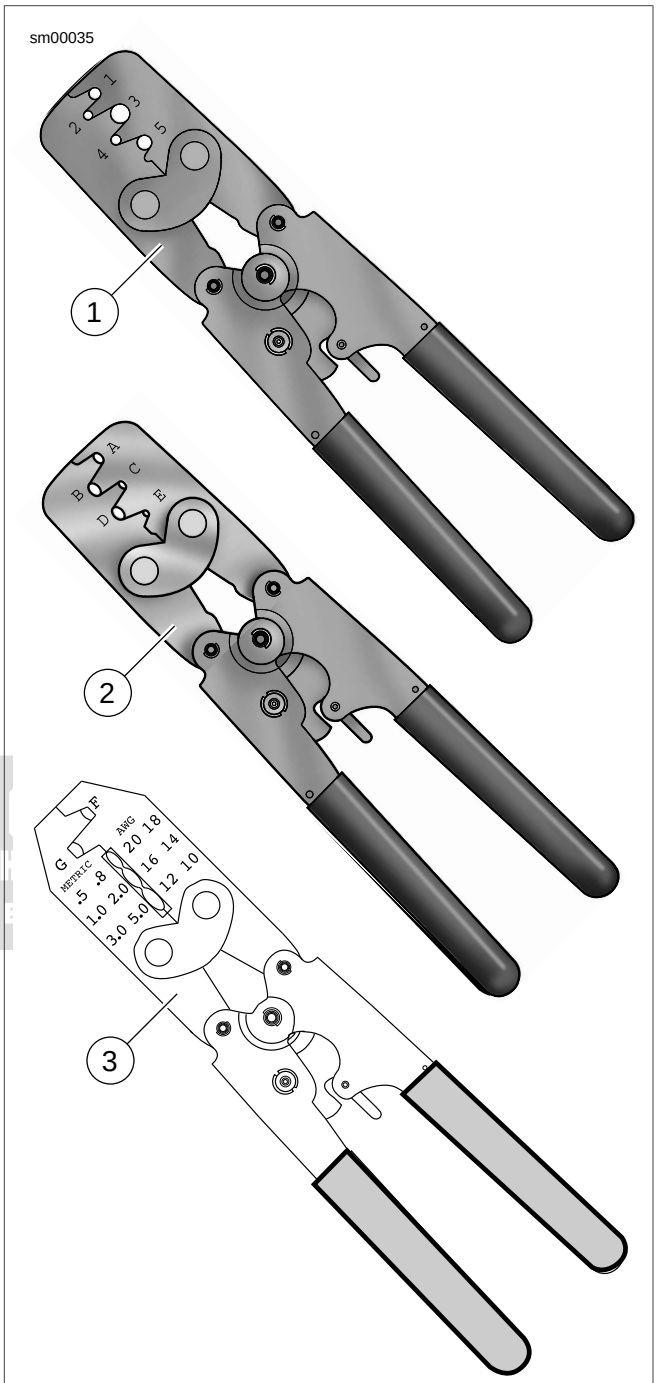
Strip 4.0 mm (5/32 in) of insulation from the wire lead.

Crimping Wire Core

NOTE

*Metri-Pack terminal crimps require two steps. Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.



1. **HD-38125-6 sealed terminals**
2. **HD-38125-7 non-sealed terminals**
3. **HD-38125-8 non-sealed terminals**

Figure A-13. Metri-Pack Terminal Crimp Tools

Crimping Insulation/Seal

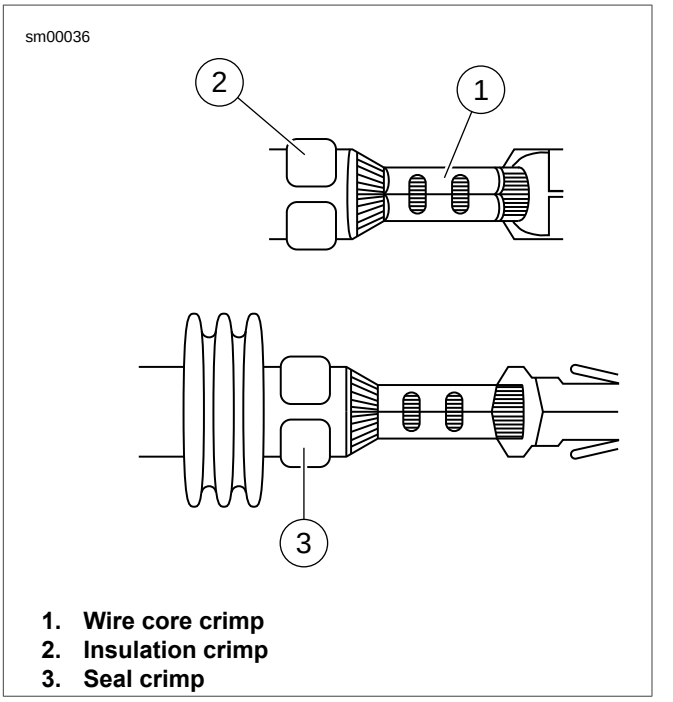
NOTE

*Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. See Figure A-14. Identify the correct die for the insulation/seal crimp (2).
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

Inspecting Crimps

1. See Figure A-14. Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.



1. **Wire core crimp**
2. **Insulation crimp**
3. **Seal crimp**

Figure A-14. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps

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DELPHI MICRO 64 SEALED CONNECTORS A.9

DELPHI MICRO 64 SEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-45928	TERMINAL REMOVER
HD-45929	TERMINAL CRIMPER

General

Delphi Micro 64 Sealed connectors are frequently found on speedometers, tachometers and the ECM of Touring Models.

Separating Pin and Socket Housings

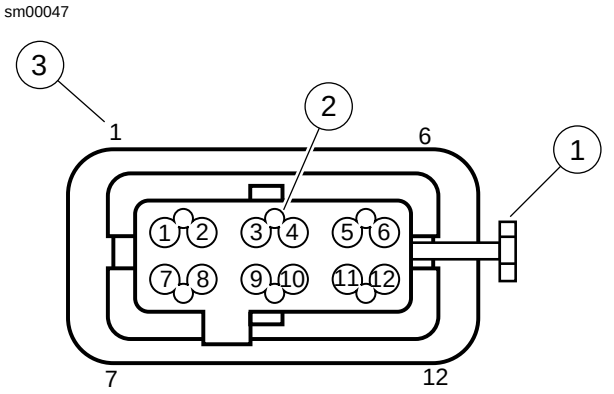
Bend back the external latches slightly and separate the pin and socket housings.

Mating Pin and Socket Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

Removing Terminal

1. See Figure A-15. Locate the head of the secondary lock (1) on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole (2) between terminals on mating end of connector.



1. **Secondary lock**
2. **Pin hole**
3. **Stamped number**

Figure A-15. Delphi Micro-64 Sealed Connector: Housing

4. See Figure A-16. Obtain the TERMINAL REMOVER (Part No. HD-45928).
5. See Figure A-17. Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.



Figure A-16. Terminal Remover (HD-45928)

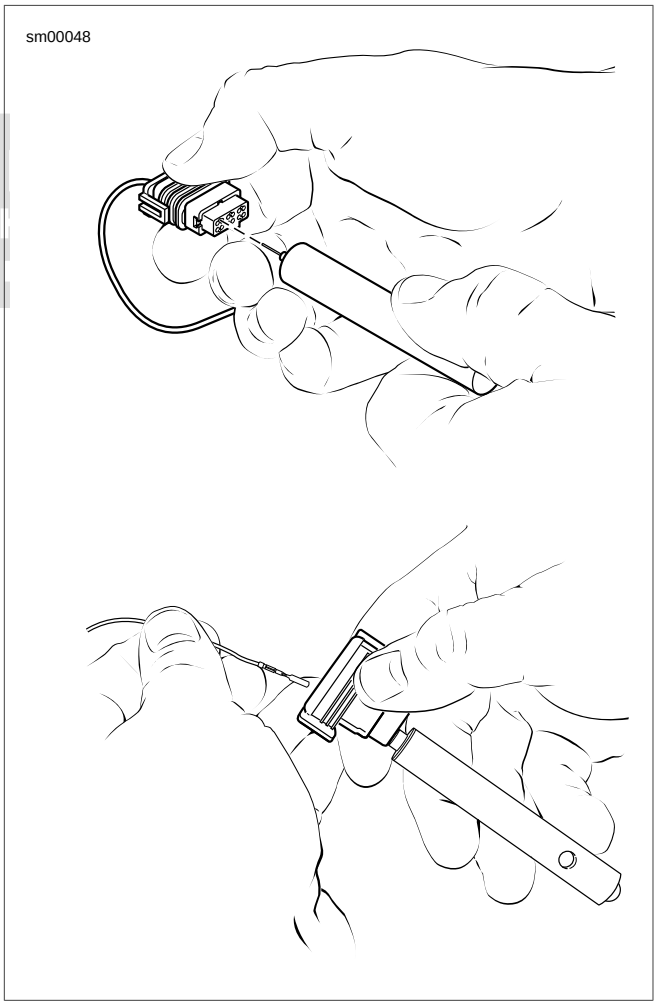


Figure A-17. Delphi Micro-64 Sealed Connector: Insert Tool and Remove Terminal

Installing Terminal

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

See Figure A-15. For wire location purposes, the corners of the socket housing are stamped (3) with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.

2. Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.

NOTE

Once the terminal is removed it may not lock in place when first installed. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.

3. Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.

4. With the center ear on the head of the secondary lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

Preparing Wire Leads for Crimping

Strip 3.0 mm (1/8 in) of insulation from the wire lead.

Crimping Terminals

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.

2. See Figure A-19. Squeeze the handles of the TERMINAL CRIMPER (Part No. HD-45929) to cycle the tool to the fully open position (1).

3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).

4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).

5. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails and the closed side of the terminal rests on the outer nest of the crimp tool.

6. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.

7. Squeeze handle of crimp tool until tightly closed (4). Tool automatically opens when the crimping sequence is complete.

8. Raise locking bar and barrel holder to remove contact.

Inspecting Crimps

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

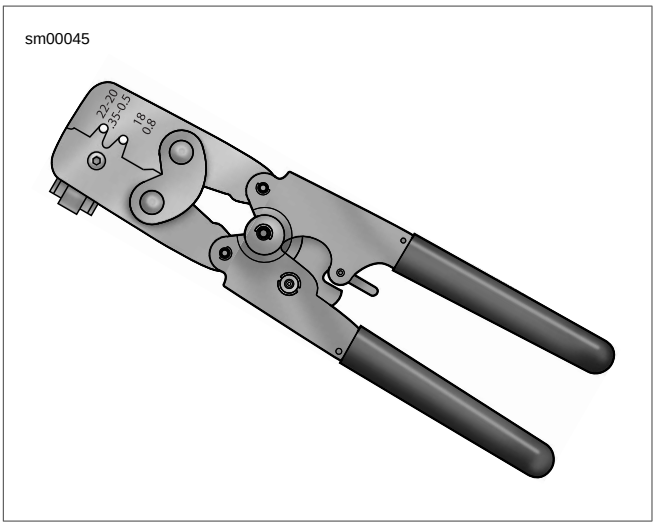
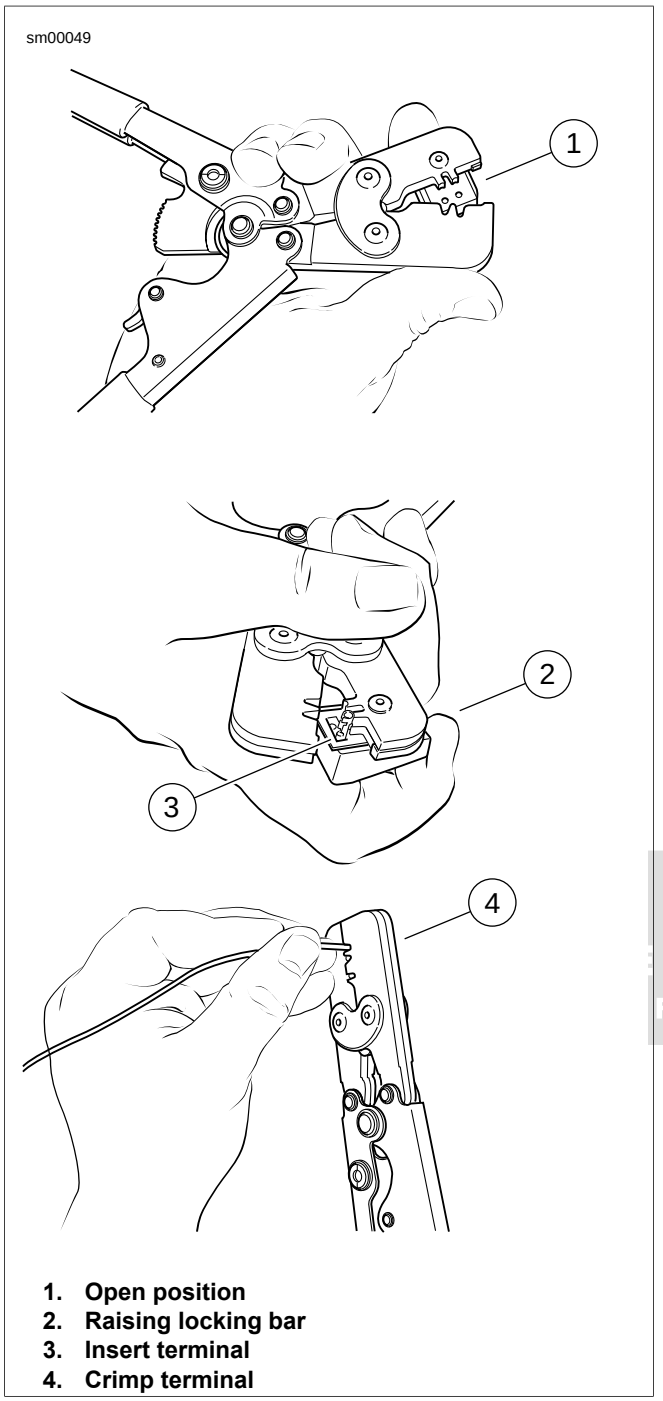


Figure A-18. Terminal Crimper (HD-45929)

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1. Open position
2. Raising locking bar
3. Insert terminal
4. Crimp terminal

Figure A-19. Delphi Micro-64 Sealed Connector: Terminal in Crimper

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DELPHI GT 150 SEALED CONNECTORS A.10

DELPHI GT 150 SEALED CONNECTOR REPAIR

General

Delphi connectors are embossed with the brand name, Delphi, on the housing latch or terminal block.

Separating Pin and Socket Housings

See Figure A-20. Bend back the external latch(es) slightly and separate pin and socket halves of connector.

Mating Pin and Socket Housings

Push pin and socket halves of connector together until external latch(es) engage.

Removing Socket Terminals

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all.

1. See Figure A-21. If present, free one side of wire lock (1) from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Use the thin flat blade from a hobby knife. Gently pry tang (3) outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove.

Installing Socket Terminals

NOTE

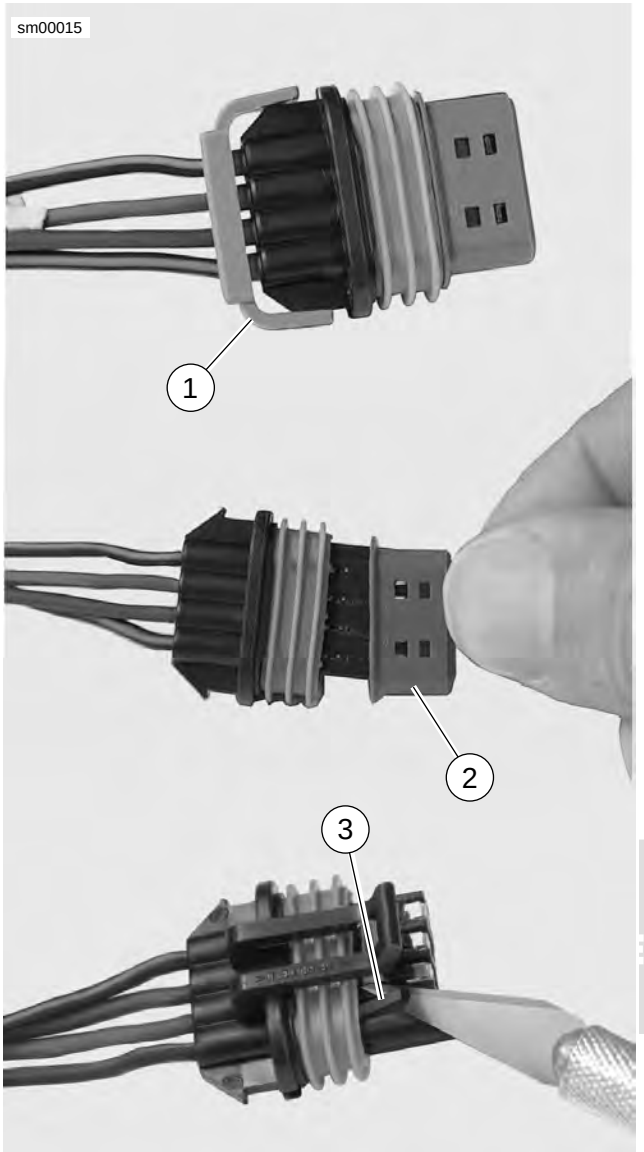
For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

1. Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
2. Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
3. Install colored terminal lock onto mating end of socket housing.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.



Figure A-20. Delphi GT 150 Sealed Connector: Socket Housing Latch

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1. **Remove wire lock**
2. **Remove terminal lock**
3. **Pry tang outward**

Figure A-21. Delphi GT 150 Sealed Connector: Removing Socket Terminals

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DELPHI GT 280 SEALED 73-TERMINAL ECM CONNECTOR A.11

DELPHI GT 280 SEALED 73-TERMINAL ECM CONNECTOR

NOTE

Do not operate latch lever when connector is not mated to ECU. Damage will occur.

Separating Socket Housing From ECM

NOTE

Although this procedure shows the ECM removed, the ECM connector can be removed and installed with the ECM removed or in place.

See Figure A-22. Remove strap. While pressing latch (1), rotate lock lever to the released position (2).

Mating Socket Housing To ECM

Push the connector into the ECM and rotate lock lever to the locked position.

Socket Terminal

1. Cut cable strap to release harness from strain relief collar of connector housing.
2. See Figure A-23. Release latches (4) that retain cover (3) to housing (2) and remove cover.
3. Follow instructions in A.9 DELPHI MICRO 64 SEALED CONNECTORS to remove and service the Micro-64 terminals.
4. Install connector housing cover. Verify all wires are within the confines of the cover and that the cover latches are engaged.
5. Install **new** cable strap cable to the strain relief of the connector.

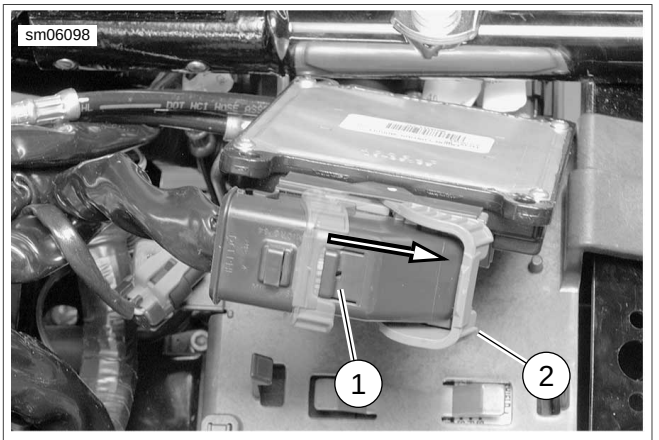
ECM Ground Terminal

1. See Figure A-23. Remove secondary lock (1).
2. See Figure A-24. Using a thin blade screwdriver, gently pry ground terminal retainer from connector housing.
3. See Figure A-25. Using a thin blade screwdriver, release latch and pull ground wire, wire seal and terminal from cover side of housing.
4. Follow instructions in A.8 DELPHI METRI-PACK TERMINAL REPAIR to replace the terminal or wire seal.
5. Push the terminal into place from the cover side of the connector housing until the latch engages. Pull on wire to verify terminal is secure.

NOTE

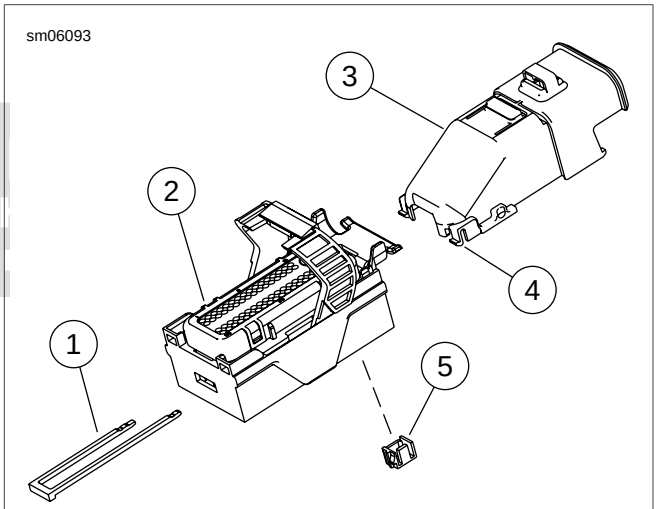
See Figure A-23. Secondary lock has one short leg and one long leg. Install as shown.

6. See Figure A-23. Install ground secondary lock (5) and install secondary lock (1) as shown.



1. **Latch**
2. **Lock lever released**

Figure A-22. Unlatch ECM Connector



1. **Secondary lock**
2. **Terminal housing**
3. **Cover**
4. **Cover latch**
5. **Ground secondary lock**

Figure A-23. Delphi 73-Terminal ECM Connector

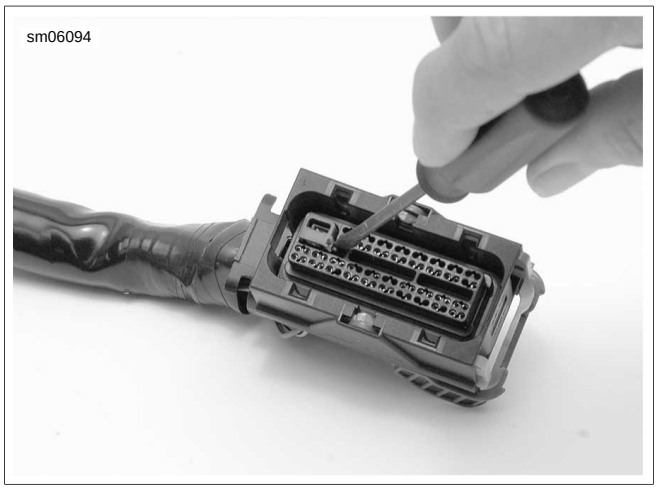


Figure A-24. Remove Ground Secondary Lock

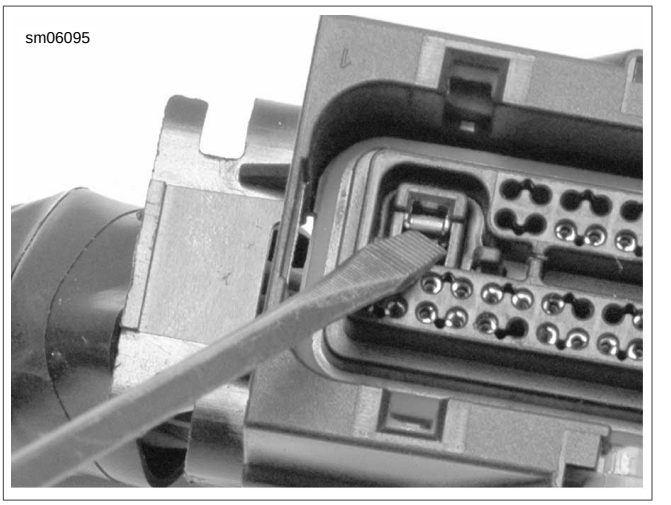


Figure A-25. Remove ECM Ground Terminal

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DEUTSCH DT SEALED CONNECTORS A.12

DEUTSCH DT SEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41475	DEUTSCH TERMINAL REPAIR KIT
HD-41475-100	FLAT BLADE L-HOOK

General

Deutsch DT Sealed connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are **black**.

NOTE

A DEUTSCH TERMINAL REPAIR KIT (Part No. HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and a FLAT BLADE L-HOOK (Part No. HD-41475-100) is used for the removal of all types of locking wedges.

Separating Pin and Socket Housings

See Figure A-26. To separate the connector halves, Press the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

NOTES

- *Generally, the socket housing is found on the accessory side, while the pin housing is attached to the wiring harness.*
- *Six-place and smaller Deutsch connectors have one latch on the connector.*
- *Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.*

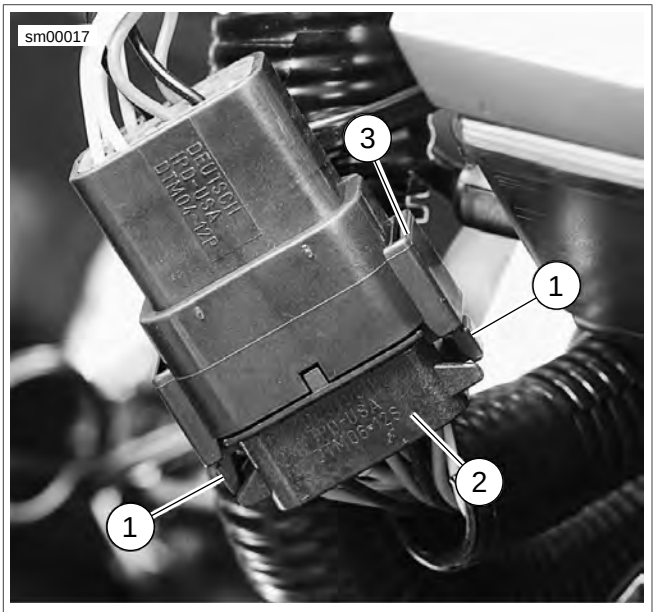
Mating Pin and Socket Housings

1. Align the connectors to match the wire lead colors.
 a. **For One External Latch:** Six-place and smaller Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.
 b. **For Two External Latches:** Align the tabs on the socket housing with the grooves on the pin housing.
2. Insert socket housing into pin housing until it snaps or clicks into place.

NOTE

***For Two External Latches:** If latches do not click (latch), press on one side of the connector until that latch engages then press on the opposite side to engage the other latch.*

3. If necessary, fit the attachment clip to the pin housing.
4. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.



1. **External latch**
2. **Socket housing**
3. **Pin housing**

Figure A-26. Deutsch DT Sealted Connector

Removing Socket Terminals

1. See Figure A-27. Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. See Figure A-30. Use a pick or small screwdriver to press terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

*If wire leads require **new** terminals, see the instructions for crimping terminals.*

Installing Socket Terminals

1. Match wire lead color to connector cavity.
2. See Figure A-29. Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead (3) approximately 25.4 mm (1.0 in) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it clicks in place.
4. A tug on the wire will confirm that it is properly locked in place.

NOTE

Install seal plugs (6) into unused chambers. If removed, seal plugs must be replaced to seal the connector.

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *See Figure A-28. While rectangular wedges do not require a special orientation, align arrow (1) on conical secondary locking wedge towards external latch for three-place connectors.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. Unseated terminals prevent the locking wedge from proper installation.*

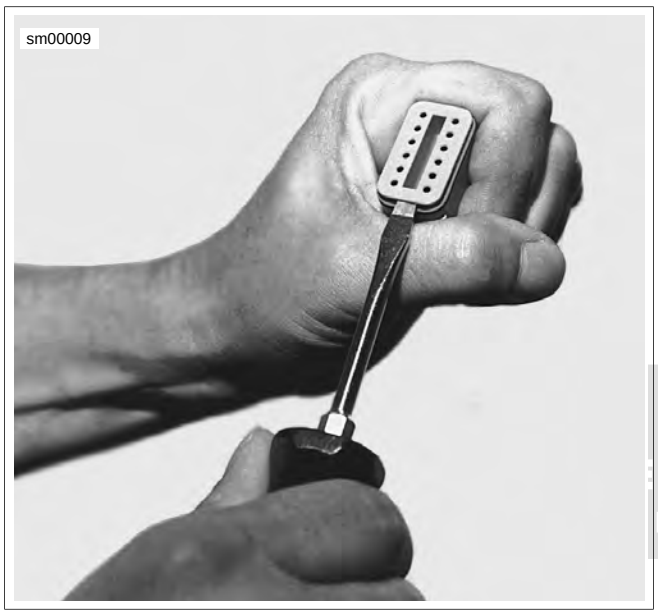
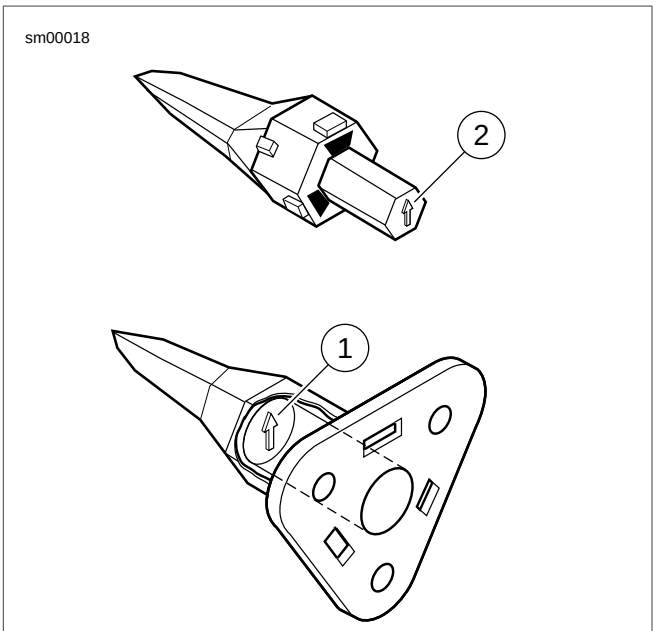


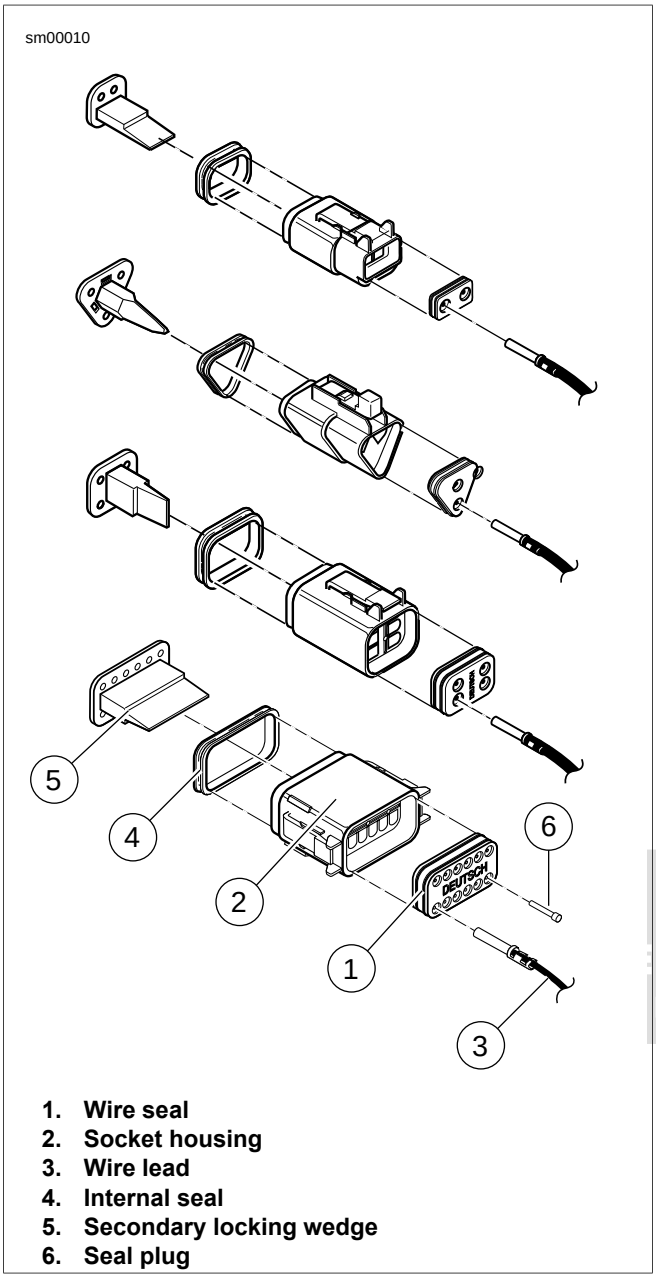
Figure A-27. Deutsch DT Sealed Connector: Remove Secondary Locking Wedge



1. **Arrow on socket locking wedge**
2. **Arrow on pin locking wedge**

Figure A-28. Deutsch DT Sealed Connector: 3-Place Locking Wedges

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1. **Wire seal**
2. **Socket housing**
3. **Wire lead**
4. **Internal seal**
5. **Secondary locking wedge**
6. **Seal plug**

Figure A-29. Deutsch DT Sealed Connector: 2, 3, 4 and 12-Place Socket Housings

Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.
2. Gently Press terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

- *If wire leads require **new** terminals, see the instructions for crimping terminals.*
- *If it should become necessary to replace a pin or socket housing, note that the 8-place and 12-place gray and black connectors are not interchangeable. If both the socket and pin housings are to be replaced, then the black may be substituted for the gray.*
- *The socket and pin housings of all other connectors are interchangeable. Black may be mated with the gray since the alignment tabs are absent and the orientation of the external latch is the same.*

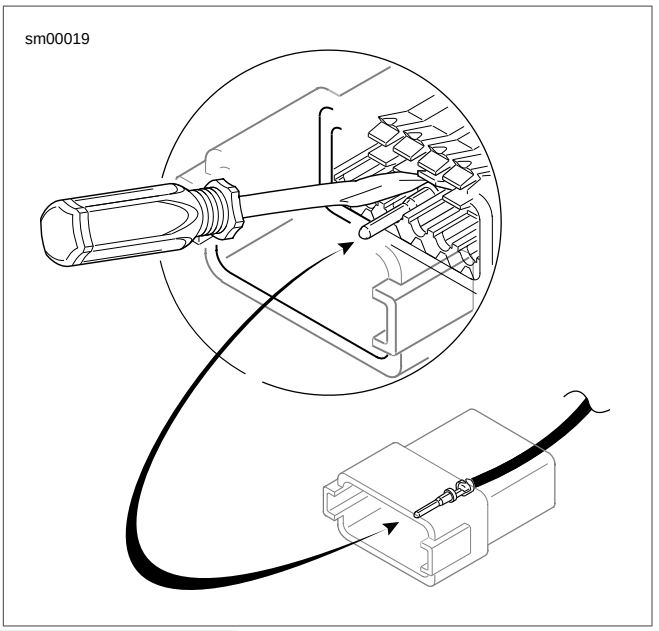


Figure A-30. Deutsch DT Sealed Connector: Depress Terminal Latch and Back Out Pin

Installing Pin Terminals

1. See Figure A-31. Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 25.4 mm (1.0 in) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

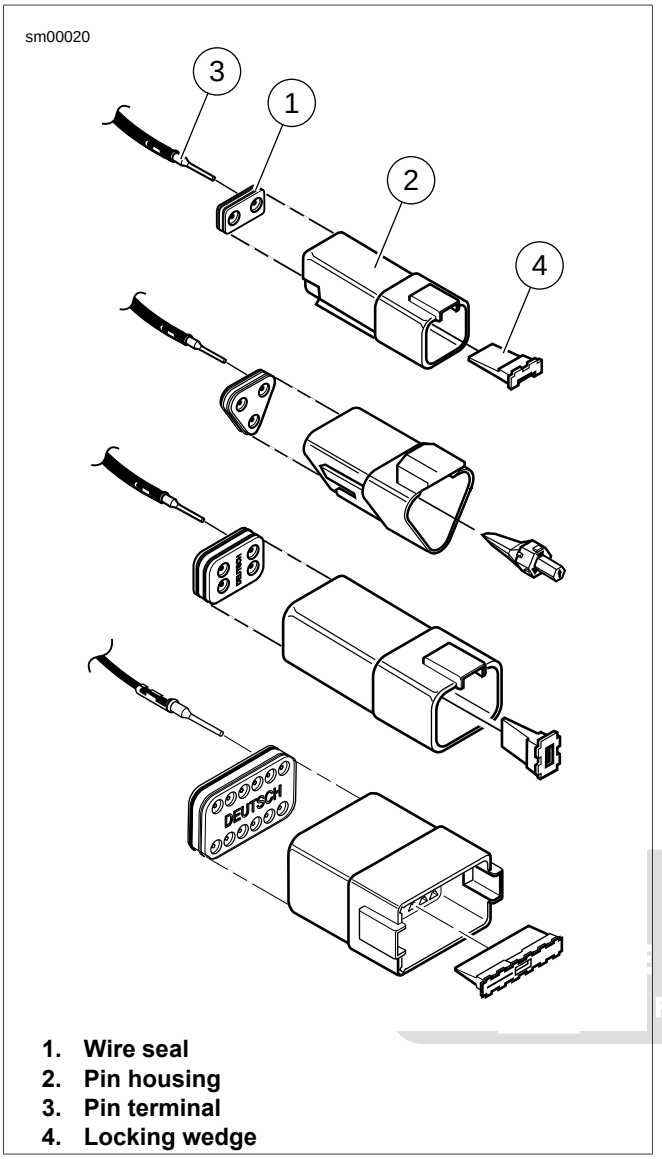
NOTE

A tug on the wire lead will confirm that a pin is locked in place.

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

NOTES

- *The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.*
- *See Figure A-28. While rectangular wedges do not require a special orientation, align arrow (1) on conical secondary locking wedge towards external latch for three-place connectors.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. Unseated terminals prevent the locking wedge from proper installation.*



1. **Wire seal**
2. **Pin housing**
3. **Pin terminal**
4. **Locking wedge**

Figure A-31. Deutsch DT Sealed Connector: 2, 3, 4 and 12-Place Pin Housings

Crimping Terminals

Identify which of the types of Deutsch terminals are used with the connector. Follow the corresponding crimping instructions. Refer to Table A-1.

Table A-1. Deutsch Connector: Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
DT Sealed (with crimp tails)	A.13 DEUTSCH DT SEALED TERMINAL REPAIR
DTM Mini Sealed Terminal (solid barrel)	A.15 DEUTSCH DTM SEALED SOLID BARREL MINI TERMINAL REPAIR
DTM Mini Sealed Terminal (with crimp tails)	A.14 DEUTSCH DTM SEALED MINI TERMINAL REPAIR

DEUTSCH DT SEALED TERMINAL REPAIR A.13

DEUTSCH DT SEALED TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL

Preparing Wire Leads for Crimping

1. Use a shop gauge to determine gauge of wire lead.
2. Strip 4.0 mm (5/32 in) of insulation from the wire lead.

Crimping Terminal to Lead

1. See Figure A-32. Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to Table A-2.
3. Release locking bar to lock terminal in die.

NOTE

If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.

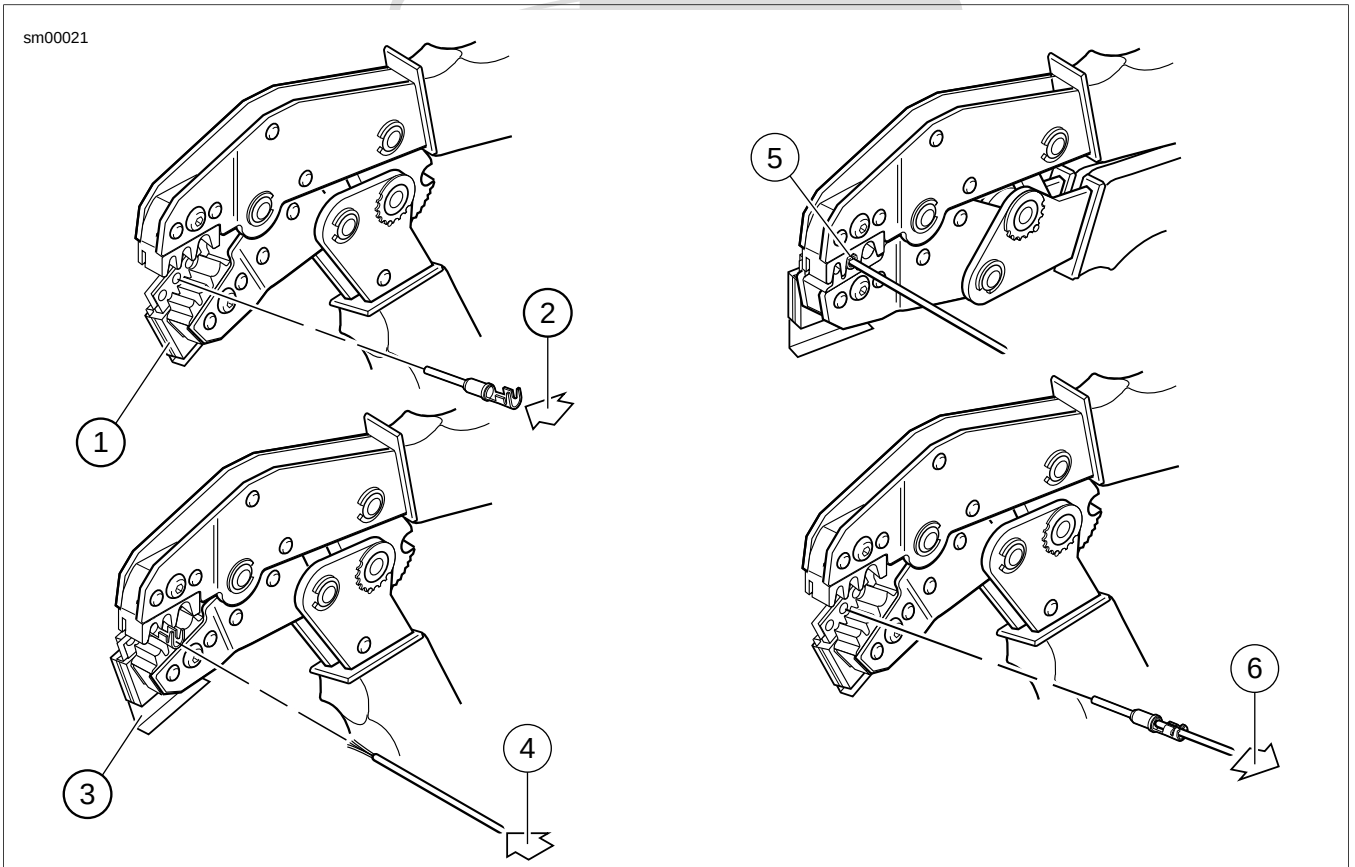
4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

Inspecting Crimps

Inspect the wire core and insulation crimps. Distortion should be minimal.

Table A-2. Deutsch DT Sealed Terminal Crimp: Wire Gauge To Die

WIRE GAUGE (AWG)	CRIMP TOOL DIE
20	Front
16-18	Middle



1. **Open jaws and raise locking bar**
2. **Insert terminal in locking bar**
3. **Release locking bar to lock terminal in die**
4. **Insert stripped lead**
5. **Squeeze crimper**
6. **Raise locking bar and remove terminal**

Figure A-32. Crimping a Deutsch DT Sealed Terminal

DEUTSCH DTM SEALED MINI TERMINAL REPAIR A.14

DEUTSCH DTM SEALED MINI TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-7	PACKARD TERMINAL CRIMPER

Preparing Wire Leads for Crimping

Strip 4.0 mm (5/32 in) of insulation from the wire lead.

Crimping a Mini Terminal to Wire Lead

1. See Figure A-33. Compress the handles of PACKARD TERMINAL CRIMPER (Part No. HD-38125-7) until the ratchet (2) automatically opens.

NOTE

Always perform core crimp before insulation crimp.

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

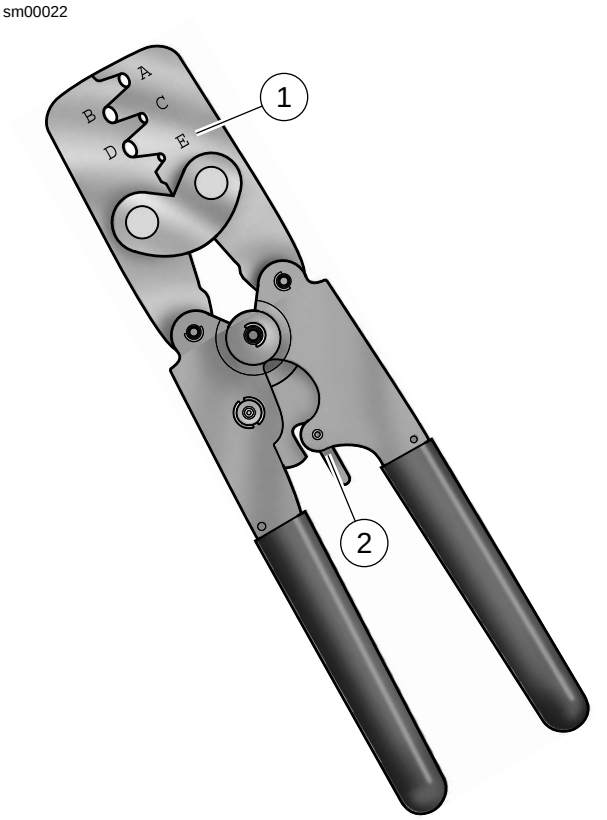
NOTE

If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspecting Crimps

Inspect the core and insulation crimps. Distortion should be minimal.



1. **E die**
2. **Crimper ratchet trigger**

Figure A-33. Packard Terminal Crimper (HD-38125-7)

DEUTSCH DTM SEALED SOLID BARREL MINI TERMINAL REPAIR A.15

DEUTSCH DTM SEALED SOLID BARREL TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-42879	ELECTRICAL CRIMPER TOOL

Preparing Wire Leads For Crimping

For size 20, 16 and 12 contacts, wire ranges 26-12 AWG.

Strip 6.4 mm (1/4 in) of insulation from the wire lead.

Adjusting Crimper Tool

1. See Figure A-34. Squeeze the ELECTRICAL CRIMPER TOOL (Part No. HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.

Crimping a Barrel Contact To Wire Lead

1. See Figure A-35. Turn tool over and drop contact barrel (1) into indentor cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indentor points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indentor.

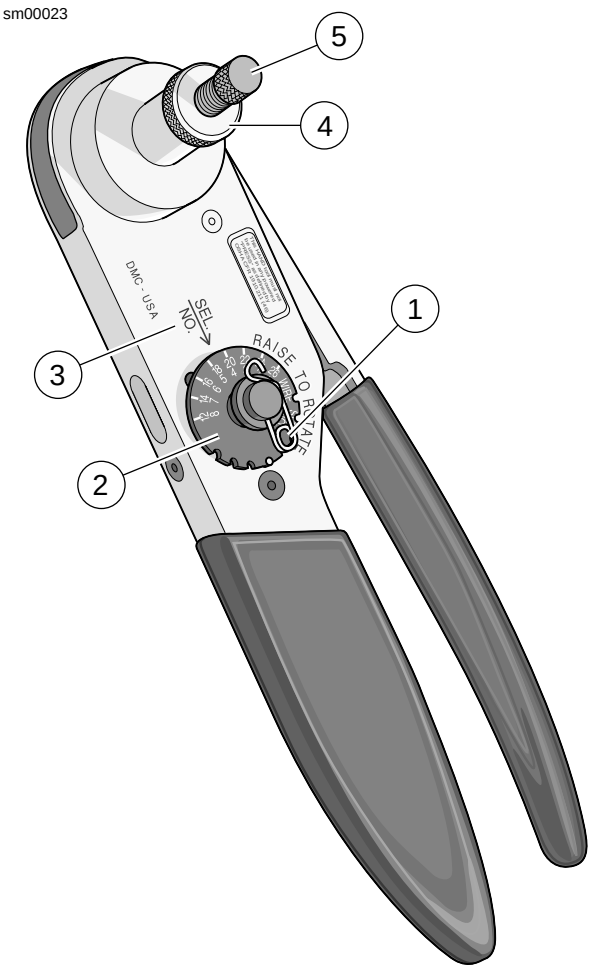
NOTE

Adjust the crimper tool for each contact/wire size.

6. Install pin to lock selector knob.

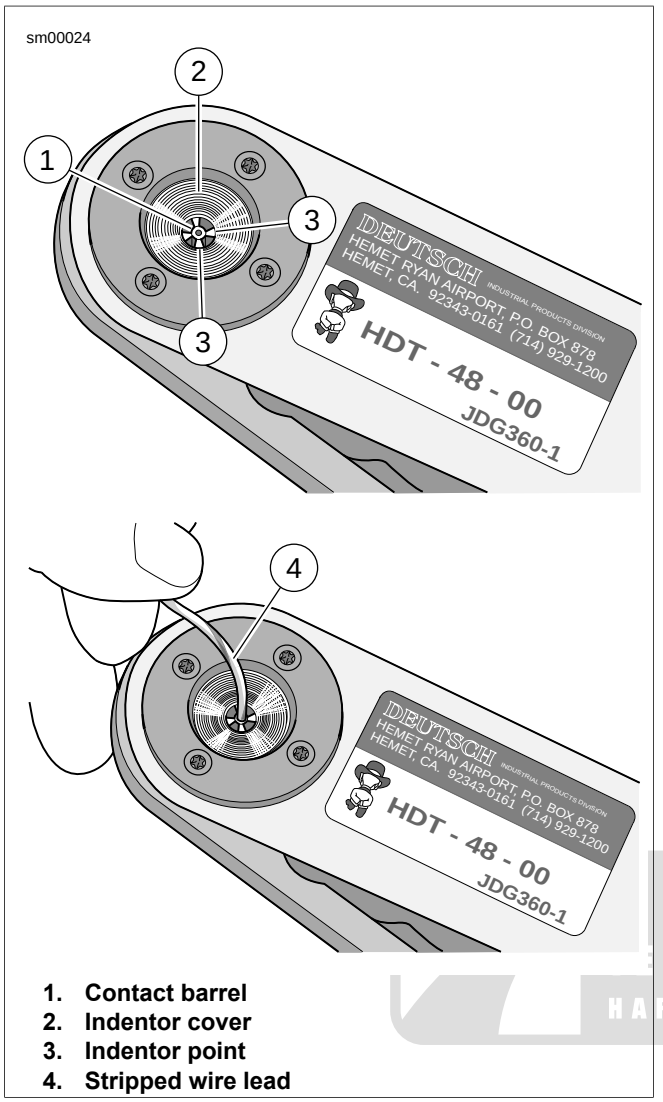
Inspecting Crimps

Inspect the crimp. All core wire strands are to be crimped in the barrel.



1. **Locking pin**
2. **Selector knob**
3. **SEL. NO. arrow**
4. **Knurled locknut**
5. **Adjusting screw**

Figure A-34. Electrical Crimper Tool (HD-42879)



1. **Contact barrel**
2. **Indentor cover**
3. **Indentor point**
4. **Stripped wire lead**

Figure A-35. Deutsch Solid Barrel

IGITAL
ECHNICIAN® II
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JAE MX19 SEALED CONNECTORS A.16

JAE MX19 SEALED CONNECTORS

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

Connector Housings

Separate Housings: See Figure A-36. Press the two release buttons on each side of the housing to separate the connector.

Connect Housings: Align and press the housings together until the locking tabs click.

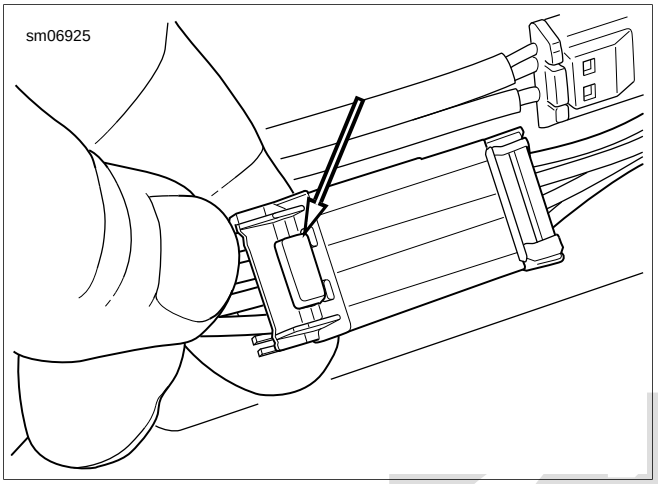


Figure A-36. Release Buttons: JAE MX19 Sealed Connector

Removing Terminals

1. Modify a TERMINAL EXTRACTOR (Part No. B-50085) by filing the front edge to 45 degrees.
2. See Figure A-37. Insert the extractor (1) into the opening above the terminal and press the plastic molding (2) up and out of the way.
3. Pull the wire lead and terminal out of the back of the housing.

Installing Terminals

1. Inspect the plastic molding and replace the connector housing if necessary.
2. Orient the terminal to the housing and push terminal into the housing until it clicks into place.

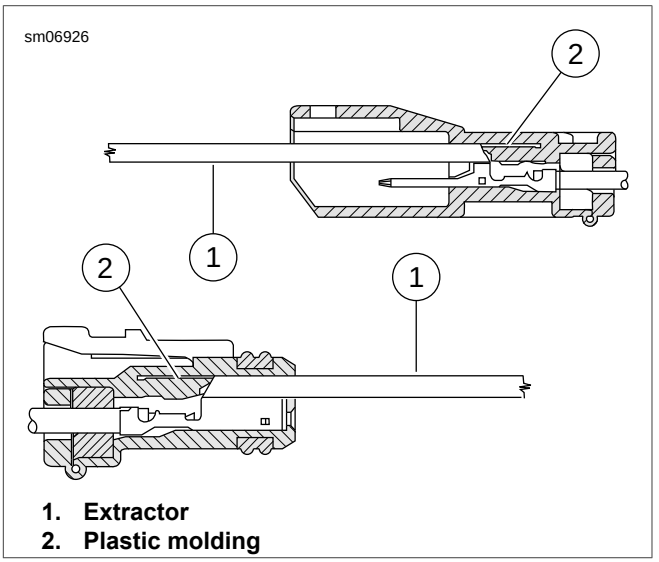


Figure A-37. JAE MX19 Terminal Removal

CRIMPING TERMINALS

PART NUMBER	TOOL NAME
HD-50120	UNIVERSAL CRIMPER SET
HD-50120-2	HAND CRIMP FRAME
HD-50120-6	JAE DIE

1. Strip the wire insulation to specification. Refer to Table A-3.
2. Install the JAE DIE (Part No. HD-50120-6) in the handle of the HAND CRIMP FRAME (Part No. HD-50120-2) of the UNIVERSAL CRIMPER SET (Part No. HD-50120).
3. Place the **new** terminal in the specified nest.
4. Insert the wire to the wire stop. Crimp the terminal.
5. Inspect the crimped terminal.

Table A-3. JAE MX19 Crimper Die (Part No. HD-50120-6)

TERMINAL	PART NO.	STRIP LENGTH		NEST
		in	mm	
Socket	72910-11	0.051-0.098	2.0-2.5	B
Pin	72909-11	0.051-0.098	2.0-2.5	A

MOLEX CMC SEALED CONNECTORS A.17

MOLEX CMC SEALED CONNECTORS

PART NUMBER	TOOL NAME
HD-50423	0.6 MM TERMINAL EXTRACTOR TOOL
HD-50424	1.5 MM TERMINAL EXTRACTOR TOOL

Separating the Connector

Release: See Figure A-38. Press the catch and rotate the lever arm down.

Connect: Press on the front guard to release the latch and rotate the lever arm up until the catch clicks in place.

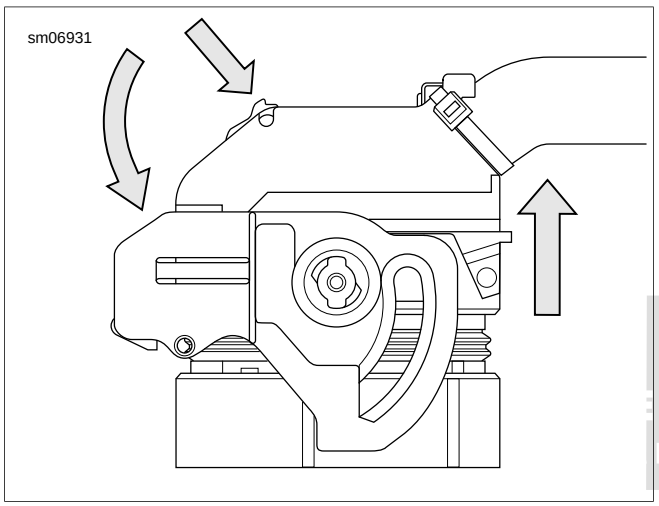


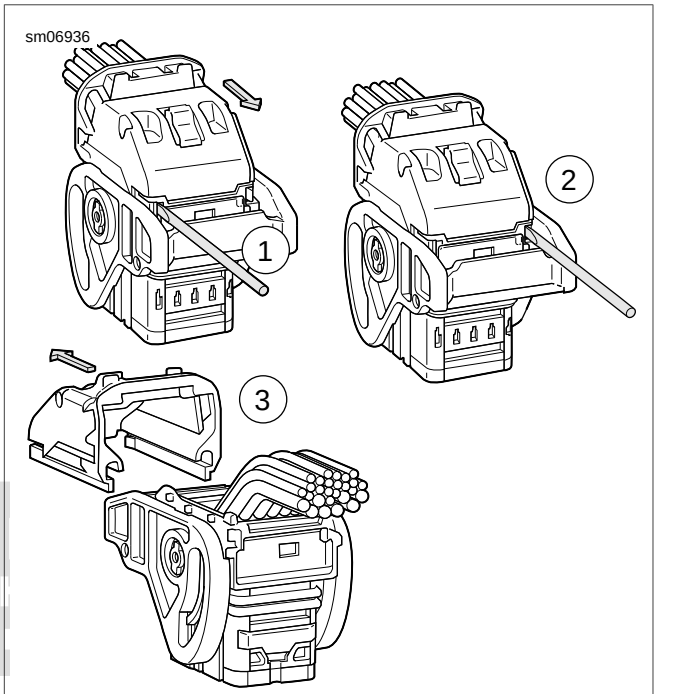
Figure A-38. Release

Removing Terminals

1. With the lever arm open, cut the cable strap around the wire bundle.
2. See Figure A-39. Open a wire cap latch (1) with a small screwdriver.
3. Maintain pressure on the cap and open the opposite latch (2) with the screw driver.
4. Slide the cap off (3).
5. See Figure A-40. Use the screwdriver to open the secondary lock. Pull the locking bar all the way out.
6. See Figure A-41. Locate the wire lead cavity by the alpha-numeric coordinates.
7. Identify the size of the terminal and select either the CMC extractor 0.6 MM TERMINAL EXTRACTOR TOOL (Part No. HD-50423) or the 1.5 MM TERMINAL EXTRACTOR TOOL (Part No. HD-50424).
8. See Figure A-42. Insert the pins of the CMC extractor tool (1) into the access slots (2) of the terminal cavity and retract the lead and terminal.

Installing Terminals

1. Orient the terminal to the housing cavity and snap the terminal in place.
2. Slide the cap over the lead bundle and snap the cap in place.
3. Install a cable strap through the guide and around the lead bundle.



1. **Press latch**
2. **Press cap and latch**
3. **Remove cap**

Figure A-39. Remove the Wire Lead Cap

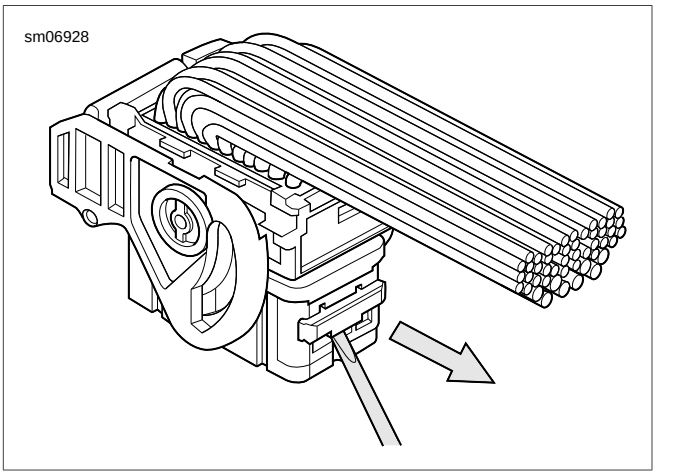
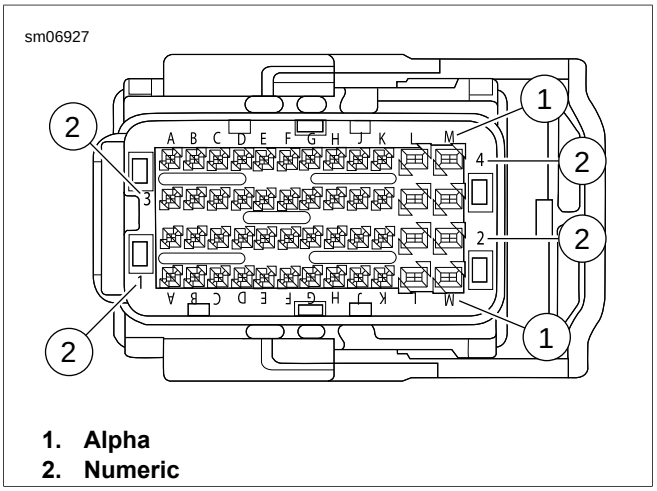
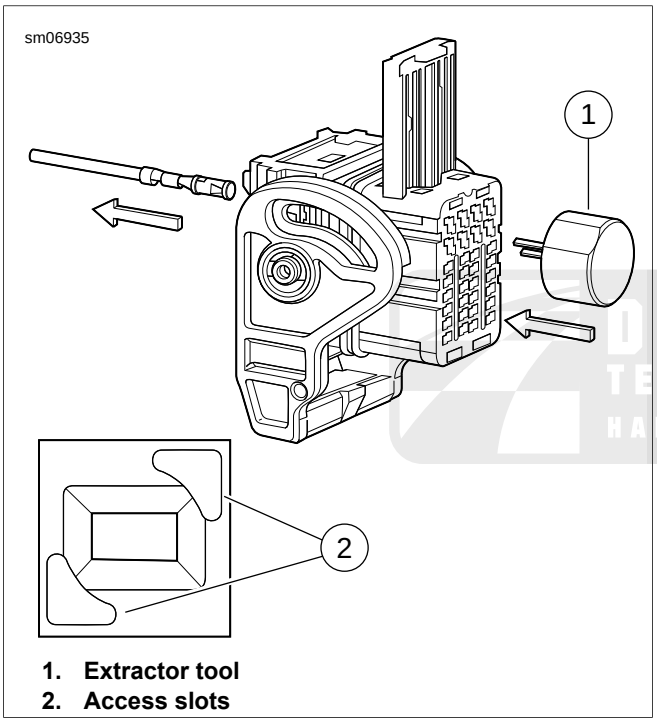


Figure A-40. Molex CMC Sealed Connector Secondary Lock



1. **Alpha**
2. **Numeric**

Figure A-41. Alpha-Numeric Coordinates



1. **Extractor tool**
2. **Access slots**

Figure A-42. Terminal Removal

CRIMPING TERMINALS

PART NUMBER	TOOL NAME
HD-50120	UNIVERSAL CRIMPER SET
HD-50120-2	HAND CRIMP FRAME
HD-50120-3	JAE DIE
HD-50120-4	JAE DIE

1. Select the crimper die according to the terminal part number from the UNIVERSAL CRIMPER SET (Part No. HD-50120).
2. Strip the wire insulation to specification. Refer to Table A-4 or Table A-5.
3. Install the JAE DIE (Part No. HD-50120-3) or JAE DIE (Part No. HD-50120-4) in the handle of the HAND CRIMP FRAME (Part No. HD-50120-2).
4. Place the **new** terminal in the specified nest.
5. Insert the wire to the wire stop. Crimp the terminal.
6. Inspect the crimped terminal.

Table A-4. Molex CMC Sealed Crimper Die (Part No. HD-50120-3)

PART NO.	TERMINAL: WIRE GAUGE	STRIP LENGTH		NEST
		in	mm	
72226-11	Socket: 16 AWG	0.177	4.5	B
72227-11	Socket: 18 AWG	0.177	4.5	A

Table A-5. Molex CMC Sealed Crimper Die (Part No. HD-50120-4)

PART NO.	TERMINAL: WIRE GAUGE	STRIP LENGTH		NEST
		in	mm	
72222-11	Socket: 18 AWG	0.138	3.5	B
72222-11	Socket: 20 AWG	0.138	3.5	A

MOLEX MX 150 SEALED CONNECTORS A.18

MOLEX MX 150 SEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-48114	TERMINAL REMOVER

Separating Pin and Socket Housings

See Figure A-43. Press the latch while pulling the pin and socket housings apart.

Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

Removing Terminals

1. Pull the secondary lock up, approximately 4.8 mm (3/16 in), until it stops.
 a. **Socket Housing:** See Figure A-44. Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
 b. **Pin Housing:** See Figure A-45. Use needle nose pliers to engage the D-holes in the center of the secondary lock.

NOTE

Do not remove the secondary lock from the connector housing.

2. See Figure A-46. Insert TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
 a. **Socket Housing:** The pin holes are inside the terminal openings.
 b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

Installing Terminals

1. See Figure A-47. From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE

Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. Determine the cavity number by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.
5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

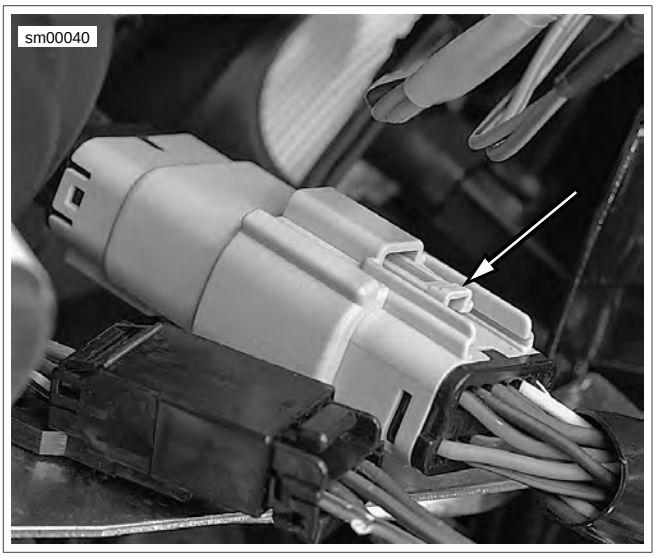


Figure A-43. Molex MX 150 Sealed Connector: Latch

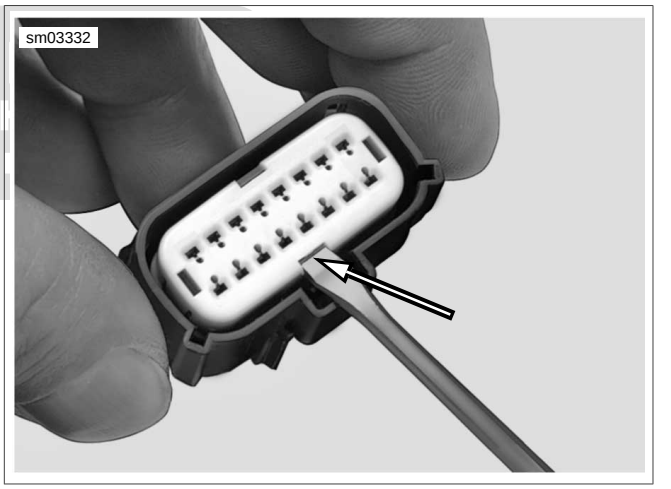


Figure A-44. Secondary Lock Pry Slot (Socket Housing)

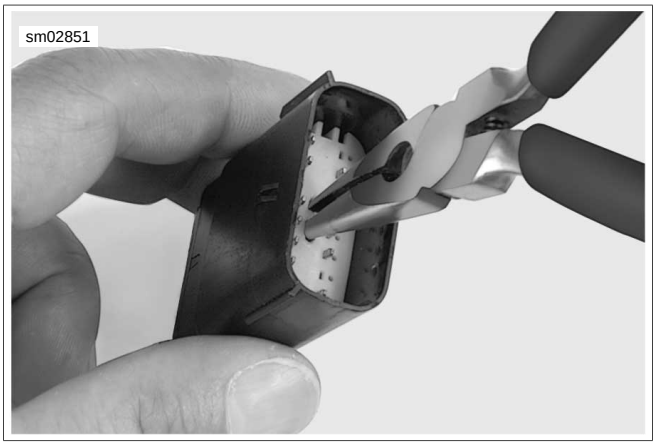


Figure A-45. Pull Up Secondary Lock (Pin Housing)

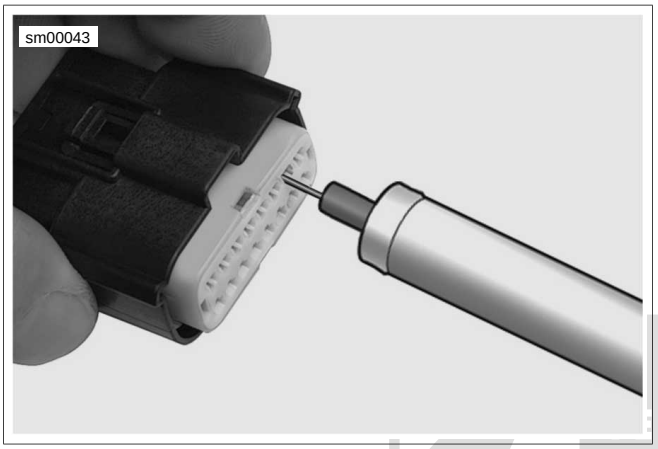
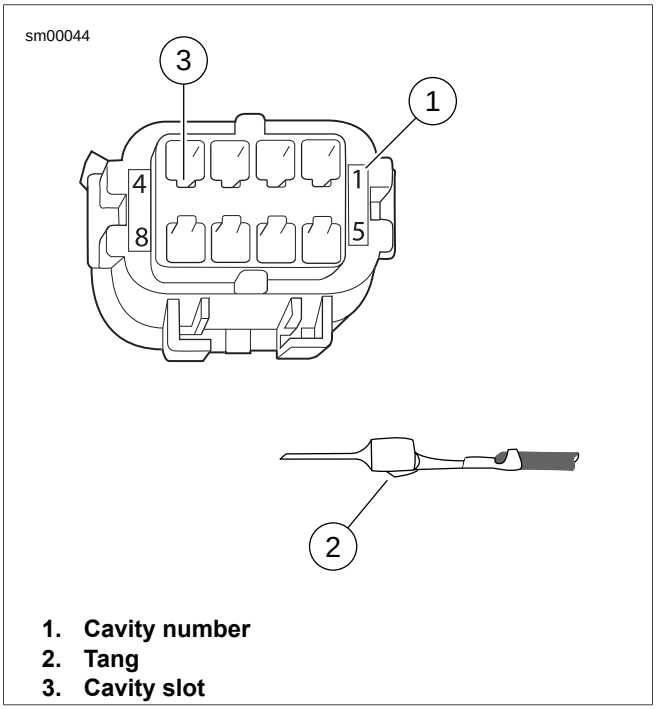


Figure A-46. Molex MX 150 Sealed Connector: Terminal Remover (HD-48114)



1. **Cavity number**
2. **Tang**
3. **Cavity slot**

Figure A-47. Molex MX 150 Sealed Connector: Pin Cavities and Wire Terminal

CRIMP TERMINAL TO LEAD

PART NUMBER	TOOL NAME
HD-48119	TERMINAL CRIMPER

Prepare Lead

1. Cut the damaged terminal close to the back of the terminal to leave as much wire length as possible.
2. Strip wire lead removing 4.70-5.60 mm (3/16 in) of insulation.

NOTE

The strip length is the same for both pin and socket terminals and for wire gauges from 22 to 14.

Prepare Tool

1. Identify the punch/die in the jaws of the TERMINAL CRIMPER (Part No. HD-48119) for the wire gauge. Refer to Table A-6.
2. Squeeze and release the handles to open the tool.

NOTE

The crimp tool automatically opens when the handles are released.

3. See Figure A-48. Hold fully open tool at approximately 45 degrees.

NOTE

Do NOT tighten the locknut holding the locator bars. The bars must float to accommodate the different terminal gauges.

Table A-6. Crimp Tool Wire Gauge Punch/Die

AWG (WIRE GAUGE)	PUNCH/DIE
22	Left
18-20	Middle
14-16*	Right
* Crimp 16 AWG **pin** terminals in the 18-20 middle die.	

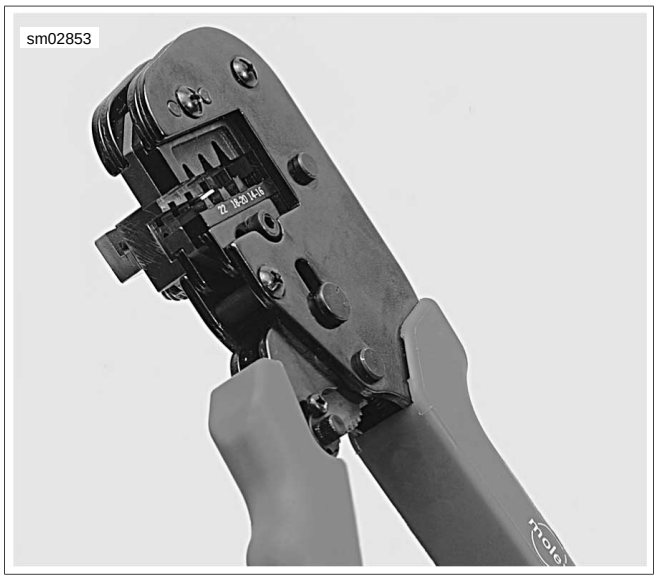
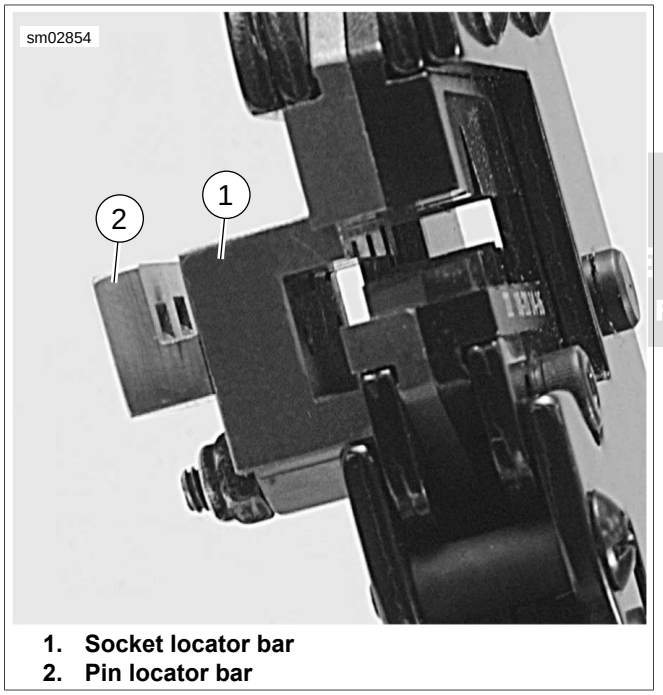


Figure A-48. Open Terminal Crimper (HD-48119) at 45 Degrees



1. **Socket locator bar**
2. **Pin locator bar**

Figure A-49. Terminal Locator Bars

Position Terminal in the Punch/Die

1. See Figure A-50. With the crimp tails up, place the terminal through the punch/die into the square opening in the socket locator bar.
 a. **Socket Terminal:** See Figure A-49. A socket terminal stops against the back face of the socket locator bar (1).
 b. **Pin Terminal:** See Figure A-51. The tip of a pin terminal passes through the socket locator bar and stops in the notch in the face of the pin locator bar.
2. See Figure A-52. Ratchet the handles together until the crimp tails are held in vertical alignment between the punch and the die.

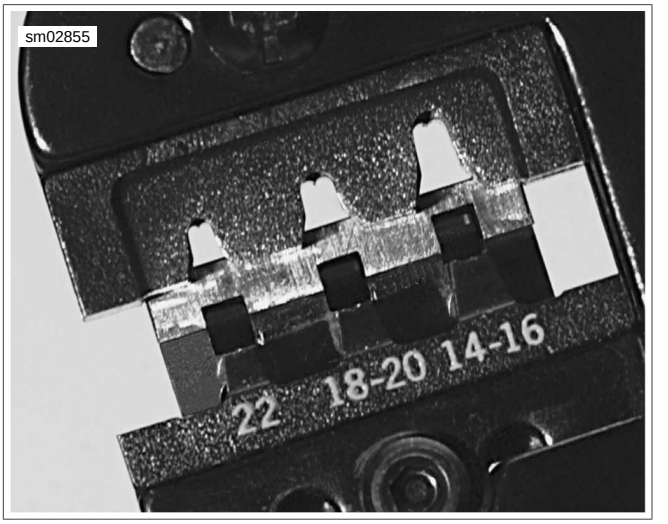


Figure A-50. Square Openings in Socket Locator Bar

Insert Stripped Lead

See Figure A-53. Insert the stripped end (wire core) between the crimp tails at an up angle until the wire core touches the face of the socket locator bar above the square opening.

NOTES

- *The insulation must extend through the insulation crimp tails.*
- *Insert the wire with little or no pressure. Pressing on the lead will bend the wire core.*

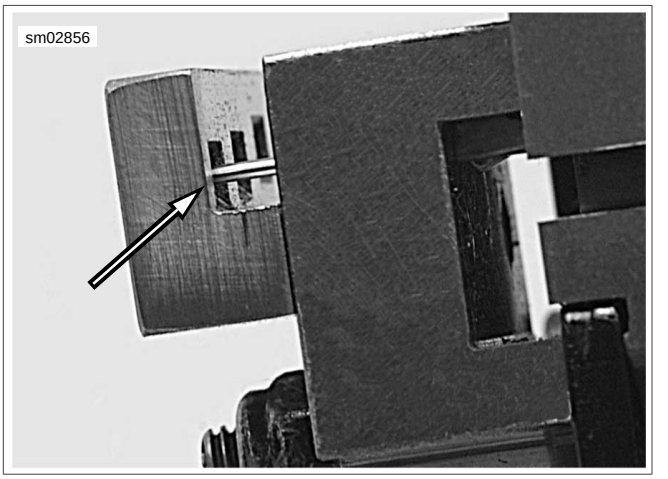


Figure A-51. Pin Terminal against Pin Locator Bar

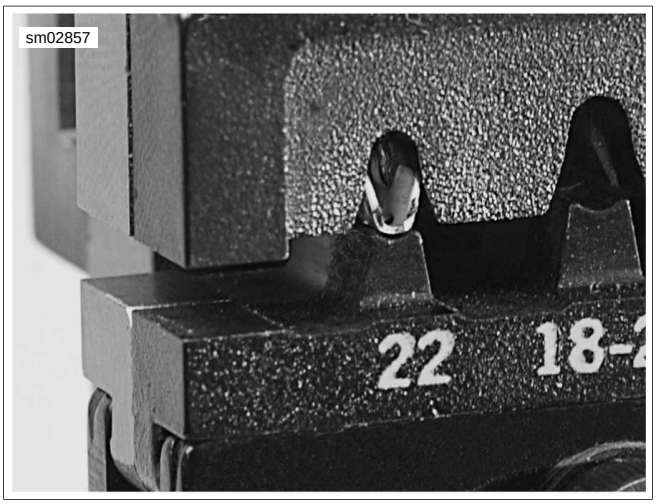


Figure A-52. Crimp Tails in Vertical Alignment between Punch and Die

Crimp Terminal to Lead

1. Holding the wire lead in position touching the locator face at an angle, quickly and smoothly squeeze the crimp tool closed.
2. Final squeeze the handles to open the tool and release the terminal.

NOTE

*Open a stuck or jammed tool by pressing the ratchet release lever found between the handles. Do **not** force the handles open or closed.*

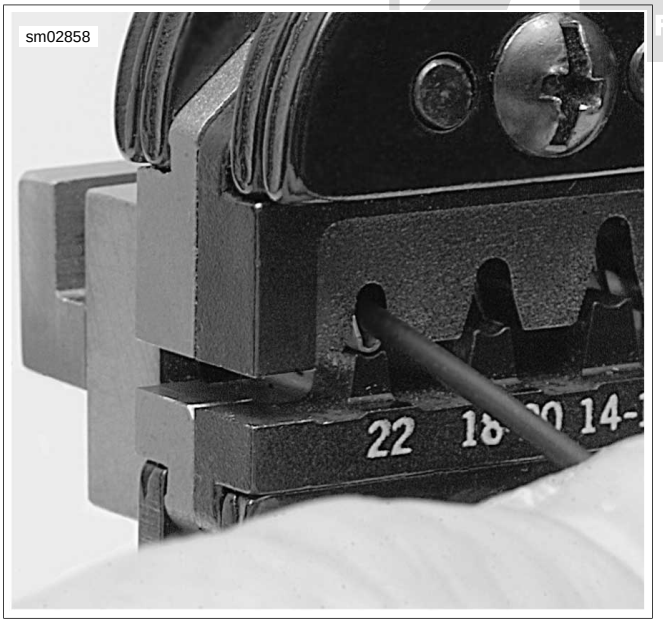
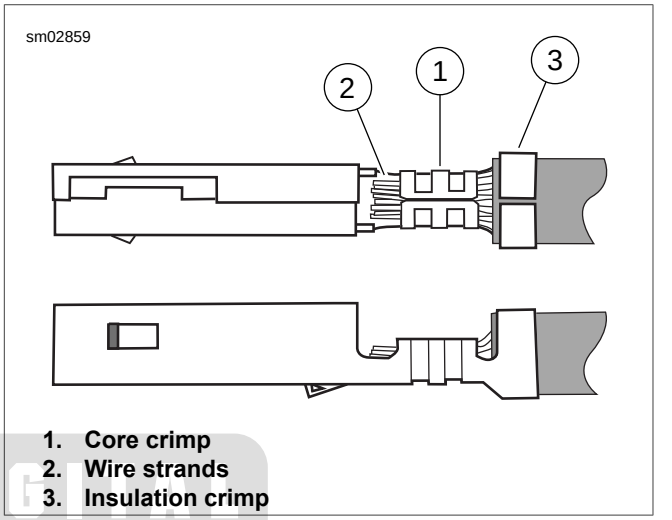


Figure A-53. Stripped Lead at Up Angle

Inspect Crimp

1. **Inspect Crimp:** Inspect the core and insulation crimp.
 a. See Figure A-54. The core tails should be creased into the wire strands at the core crimp (1).
 b. Strands (2) of wire should be visible beyond the core crimp but not forward into the terminal shell.
 c. The insulation tails should be folded into the insulation (3) without piercing or cutting the insulation.
 d. Distortion should be minimal.
2. **Test Crimp:** Hold the terminal and pull the lead.



1. **Core crimp**
2. **Wire strands**
3. **Insulation crimp**

Figure A-54. Terminal Crimp

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TYCO 070 MULTILOCK UNSEALED CONNECTOR A.19

TYCO 070 MULTILOCK UNSEALED CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41609	AMP MULTI-LOCK CRIMPER
SNAP-ON TT600-3	SNAP-ON PICK

General

Tyco 070 Multilock Unsealed connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See Figure A-55. Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

Obtain the necessary tools to repair the connector and terminals.

NOTE

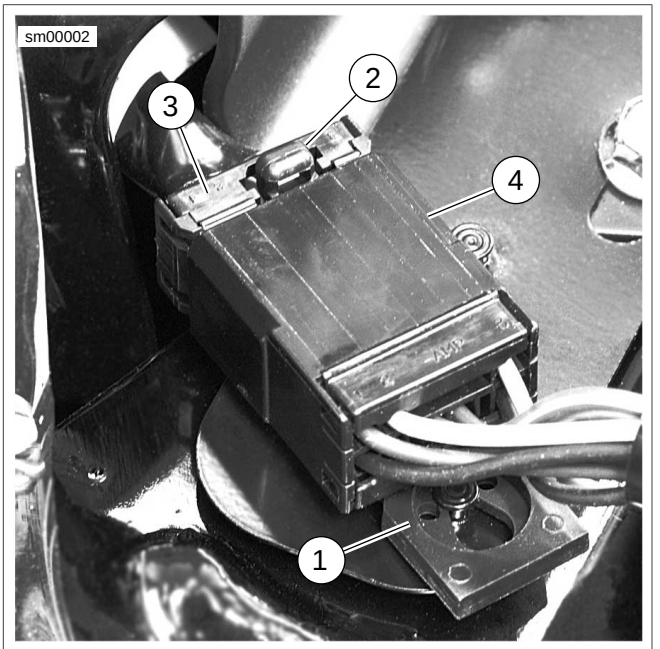
For terminal crimping use the AMP MULTI-LOCK CRIMPER (Part No. HD-41609).

Separating Pin and Socket Housings

1. If necessary, slide connector attachment clip T-stud to the large end of the opening.
2. See Figure A-55. Press the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

Mating Pin and Socket Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it clicks in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector to engage T-stud to small end of opening.



1. **Attachment clip**
2. **Release button**
3. **Socket housing**
4. **Pin housing**

Figure A-55. Tyco 070 Multilock Unsealed Connector

Removing Terminals from Housing

1. See Figure A-56. Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
2. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
3. Insert a pick or pin into the terminal cavity until it stops.

NOTE

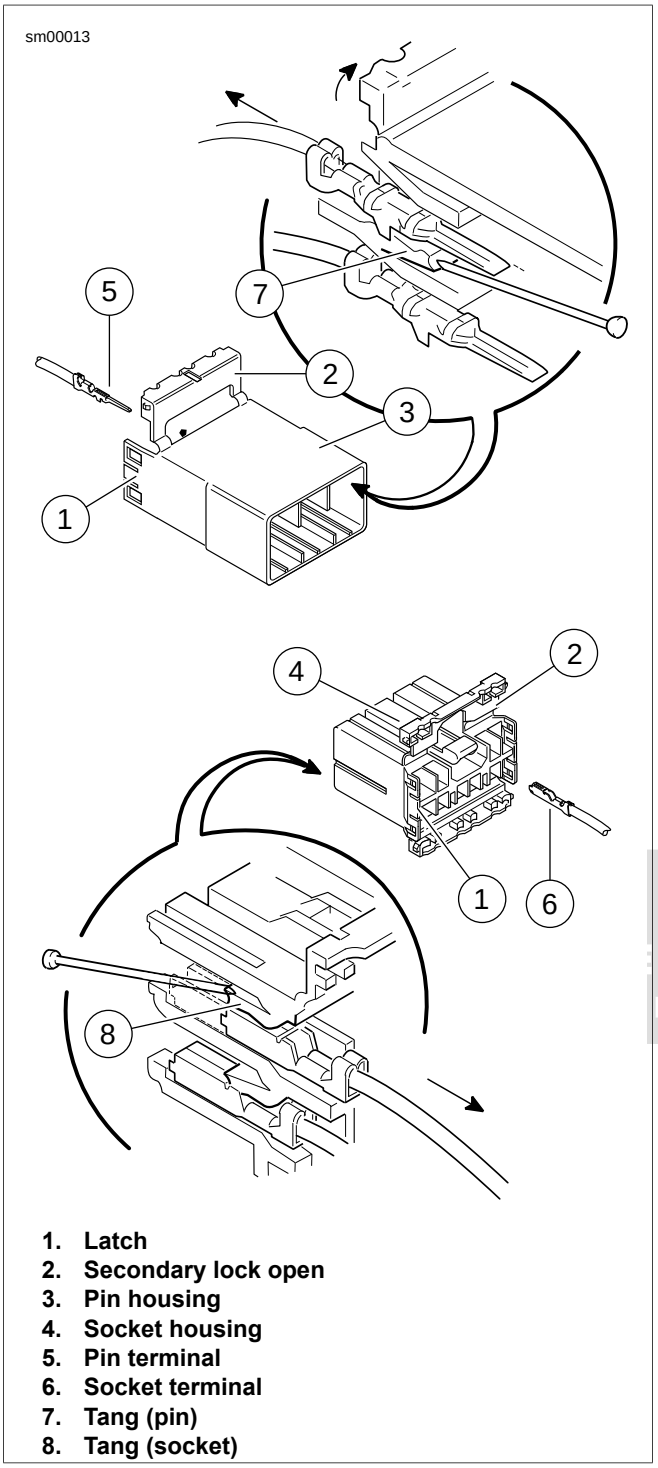
If socket/pin terminal tool is not available, use a push pin/safety pin or a SNAP-ON PICK (Part No. SNAP-ON TT600-3).

4. Press the tang in the housing to release the terminal.
 a. **Socket:** Lift the socket tang (8) up.
 b. **Pin:** Press the pin tang (7) down.

NOTE

A click is heard if the tang is released.

5. Gently tug on wire to pull wire and terminal from cavity.



1. **Latch**
2. **Secondary lock open**
3. **Pin housing**
4. **Socket housing**
5. **Pin terminal**
6. **Socket terminal**
7. **Tang (pin)**
8. **Tang (socket)**

Figure A-56. Tyco 070 Multilock Unsealed Connector: Socket and Pin Housings

Inserting Terminals into Housing

NOTE

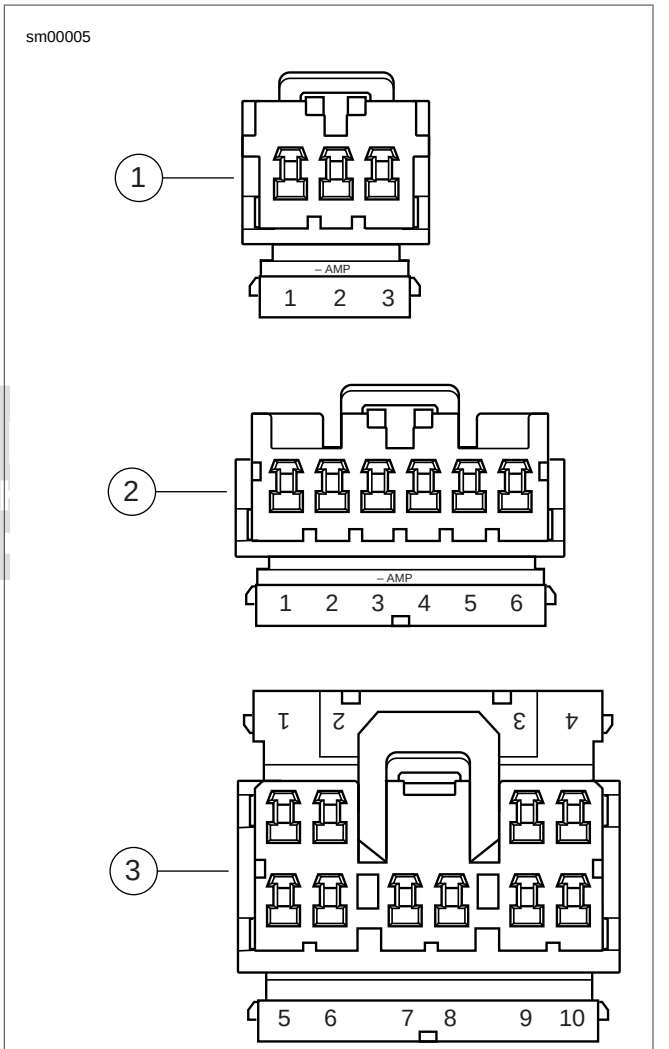
See Figure A-57. Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

NOTES

- *Up and down can be determined by the position of the release button, the button is the top of the connector.*
- *On the pin side of the connector, tangs are positioned at the bottom of each cavity, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.*

2. Gently tug on wire end to verify that the terminal is locked in place.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.



1. **3-place housing**
2. **6-place housing**
3. **10-place housing**

Figure A-57. Tyco 070 Multilock Unsealed Connector: Cavity Numbers on Secondary Locks (socket housings shown)

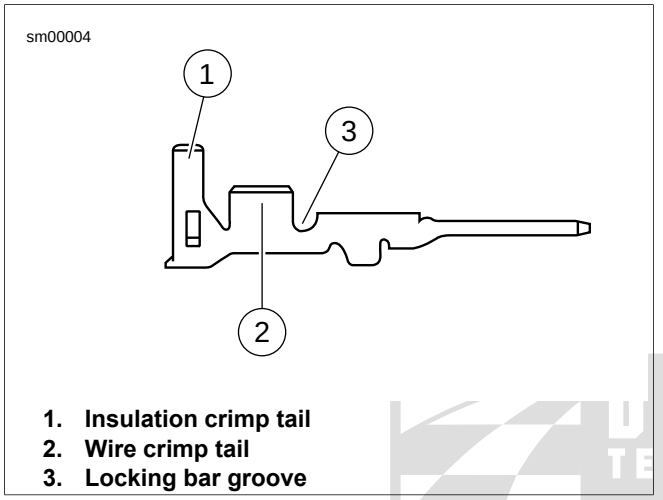
Preparing Wire Leads for Crimping

1. Strip wire lead removing 4.0 mm (5/32 in) of insulation.

2. See Figure A-58 and Figure A-59. Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3).
3. Identify the wire lead gauge and the corresponding crimper tool and nesting die. Refer to Table A-7.

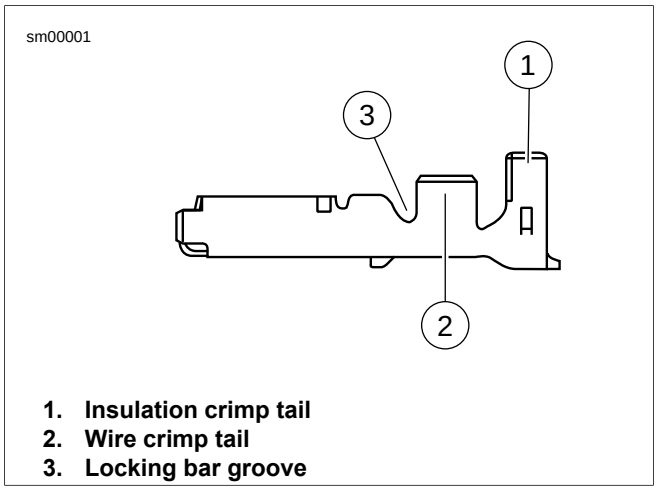
Table A-7. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest

WIRE GAUGE	NEST
20	Front
16	Middle
18	Rear



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure A-58. Tyco 070 Multilock Unsealed Connector: Pin Terminal



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure A-59. Tyco 070 Multilock Unsealed Connector: Socket Terminal

Crimping Terminals to Leads

NOTE

Crimping with the AMP Multi-lock Crimper is a one step operation. One squeeze crimps both the wire core and the insulation tails.

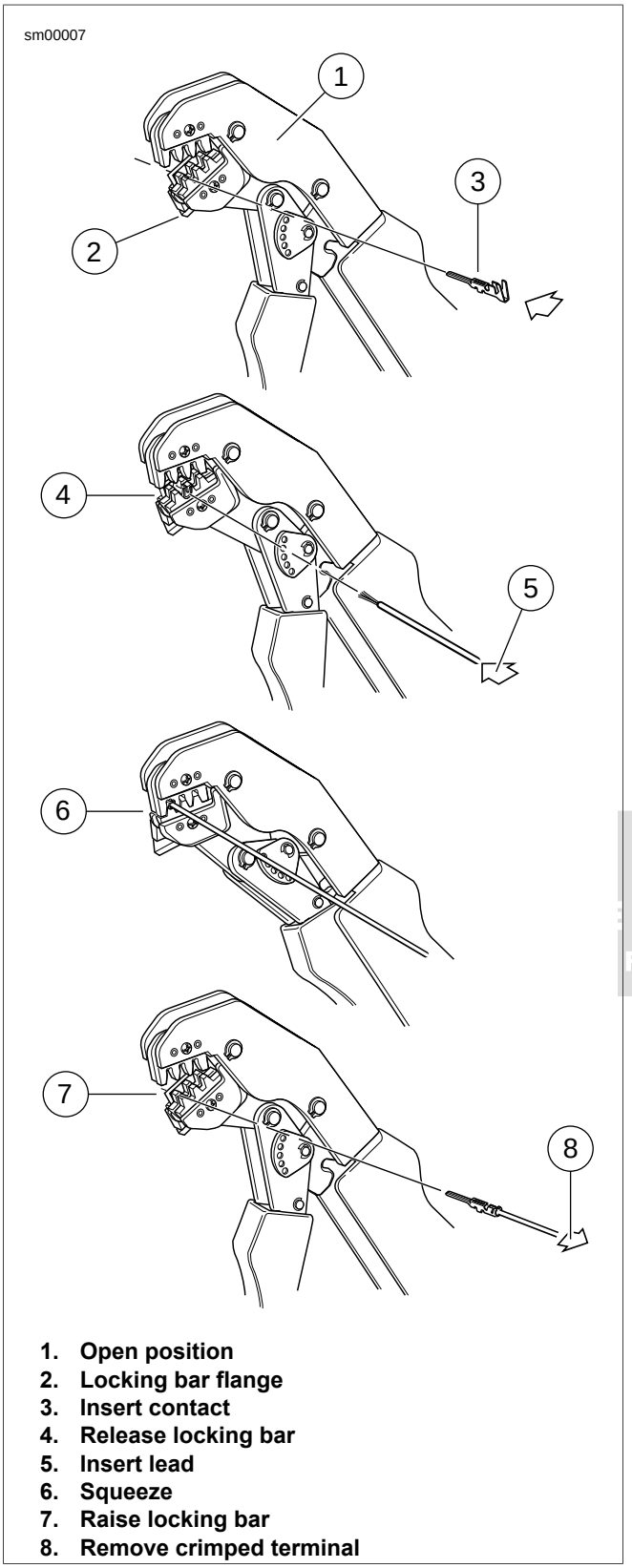
1. See Figure A-60. Squeeze the handles to cycle the AMP MULTI-LOCK CRIMPER (Part No. HD-41609) to the fully open position (1).
2. Raise locking bar by pushing up on bottom flange (2).

NOTE

See Figure A-58 and Figure A-59. Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and simultaneously crimp around the stripped lead and the insulation.

3. See Figure A-60. With the insulation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool.
4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
5. Insert stripped end of lead (5) until ends make contact with locking bar.
6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Raise up locking bar (7) and remove crimped terminal.

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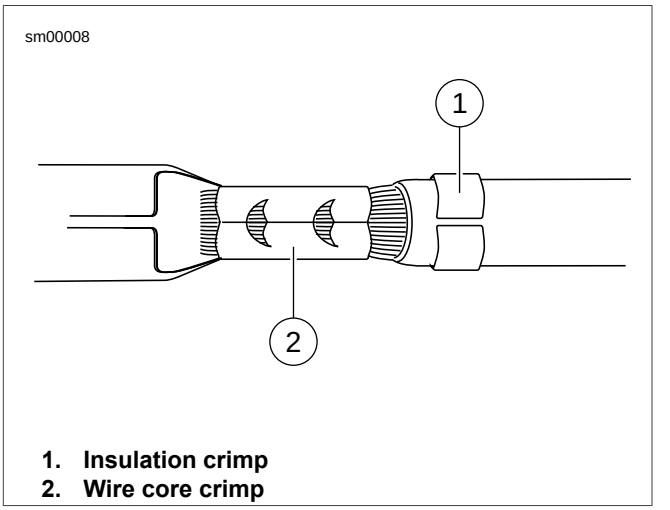


1. Open position
2. Locking bar flange
3. Insert contact
4. Release locking bar
5. Insert lead
6. Squeeze
7. Raise locking bar
8. Remove crimped terminal

Figure A-60. Tyco 070 Multilock Unsealed Connector: Terminal Crimping Procedure

Inspecting Crimped Terminals

See Figure A-61. Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.



1. Insulation crimp
2. Wire core crimp

Figure A-61. Tydo 070 Multilock Unsealed Connector: Terminal Crimp

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SEALED SPLICE CONNECTORS A.20

SEALED SPLICE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-25070	HEAT GUN
HD-38125-8	PACKARD CRIMPING TOOL
HD-39969	ULTRA TORCH
HD-41183	HEAT SHIELD ATTACHMENT

General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

Preparing Wire Leads

NOTE

When splicing adjacent wires, stagger the splices so that the sealed splice connectors will not touch each other.

1. Using a shop gauge, identify the gauge of the wire.
2. Match the wire gauge to a sealed splice connector by color and part number. Refer to Table A-8.
3. Strip insulation off the the wire lead. Refer to Table A-8.

Table A-8. Sealed Splice Connectors

WIRE GAUGE	COLOR	PART NO.	STRIP LENGTH	
			in	mm
18-20 (0.5-0.8 mm)	Red	70585-93	3/8	9.5
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8	9.5
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8	9.5

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.

Splicing Wire Leads

NOTE

See Figure A-63. The connector is crimped on one side and then the other.

1. See Figure A-62. Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See Figure A-63. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).
5. Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
6. Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

⚠WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

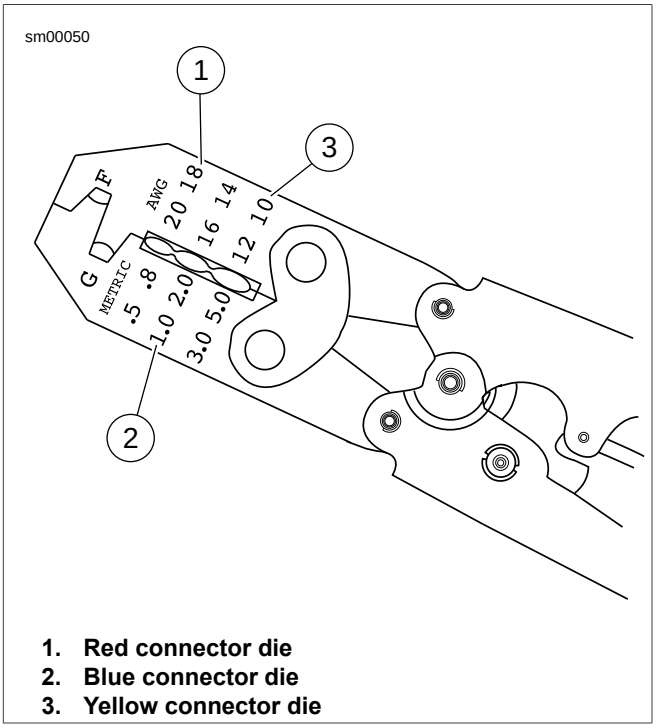
7. Use an ULTRA TORCH (Part No. HD-39969), or a HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

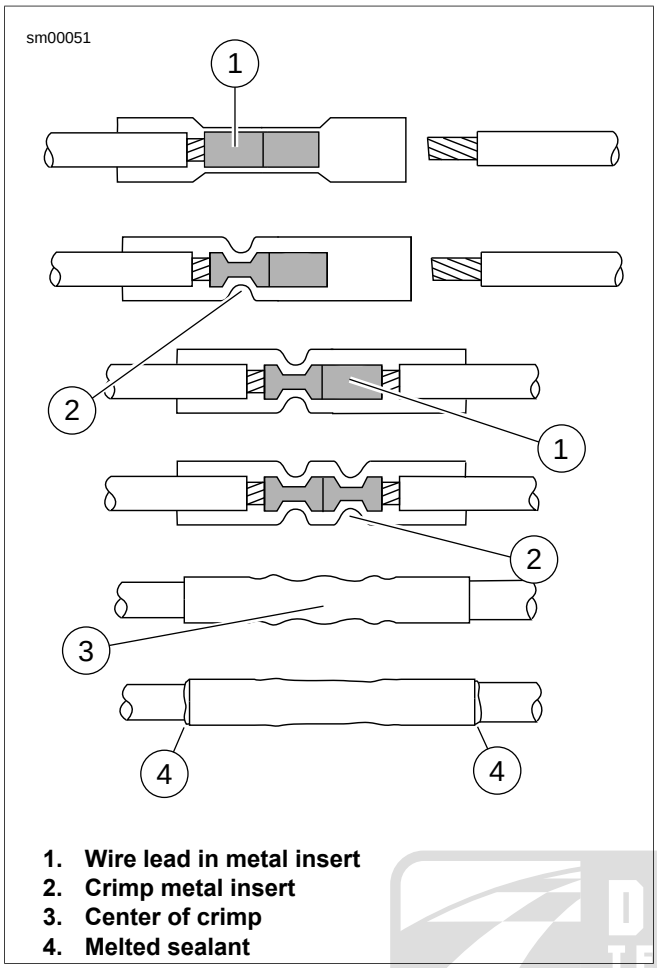
Inspecting Seals

See Figure A-63. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.



1. **Red connector die**
2. **Blue connector die**
3. **Yellow connector die**

Figure A-62. Packard Crimping Tool (HD-38125-8)



1. **Wire lead in metal insert**
2. **Crimp metal insert**
3. **Center of crimp**
4. **Melted sealant**

Figure A-63. Sealed Splice Connector

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NOTES

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B.2 WIRING DIAGRAMS	B-4

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

NOTES

CONNECTORS B.1

CONNECTOR LOCATIONS

Function/Location

On the vehicle, a connector can be identified by its function and location. Refer to Table B-1.

Place and Color

The place (number of wire cavities of a connector housing) and color of the connector can also aid identification.

Connector Number

On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets.

Repair Instructions

The repair instructions in Appendix A are by connector type. Refer to Table B-1.

Table B-1. VRSC Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[5]	Main fuse	Delphi 800 Metri-Pack Unsealed (BK)	Red	Under right side cover
[13]	Fuel level sensor	3-place Molex MX 150 Sealed (TN)	Gray	Below seat
[22]	Right hand controls	6-place Molex MX 150 Sealed (BK)	Gray	Under left side cover
[24]	Left hand controls	8-place Molex MX 150 Sealed (GY)	Gray	Under left side cover
[29]	Position lamp (HDI)	2-place Socket (BK)	Black	Back of headlamp
[30]	TSM, TSSM or HFSM	12-place Deutsch DT Sealed (GY)	Breakout Box	Under passenger seat
[31]	Front turn signals	6-place Tyco 070 Multilock Unsealed (BK)	Gray	Under left side cover
[33]	Ignition switch	3-place Faston 250 Spade terminals (BK)	Red	Back of ignition switch
[38]	Headlamp	4-place Tyco 070 Multilock Unsealed (BK)	Gray	Under left side cover
[38H]	High beam	2-place Tyco JR. Power Timer Unsealed (BK)	Purple	Back of headlamp
[38L]	Low Beam	2-place Tyco JR. Power Timer Unsealed (BK)	Purple	Back of headlamp
[39]	IM	12-place Deutsch DTM Sealed (BK)	Breakout Box	Under handlebar cover (VRSCDX) Behind headlight bracket (VRSCF)
[45]	LP lamp (HDI)	2-place Tyco 070 Multilock Unsealed (BK)	Gray	Under rear seat
[47]	Voltage regulator to stator	3-place Dekko (BK)	Green	Back of voltage regulator
[61]	Fuse block	Tyco JR. Power Timer Unsealed (BK)	Gray	Under passenger seat
[62]	Fuse block (start relay, fan relay)	Tyco JR. Power Timer Unsealed (BK)	Gray	Under right side cover
[65]	VSS	3-place Delphi GT 150 Sealed (BK)	Gray	Rear of transmission case
[77]	Voltage regulator	2-place Dekko (BK)	Green	Behind radiator cover
[78]	ECM	36-place Delphi 100W Micro-Pack Sealed (GY)	Breakout Box	Under passenger seat
[79]	CKP sensor	2-place Deutsch DTM Sealed (BK)	Brown	Under left radiator side cover

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

Table B-1. VRSC Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[80]	MAP sensor	3-place Delphi 150 Metri-Pack Sealed (GY)	Gray	Front intake passage
[83F]	Front plug-top ignition coil	3-place Delphi GT 150 Sealed (BK)	Gray	On top of front cam cover
[83R]	Rear plug-top ignition coil	3-place Delphi GT 150 Sealed (BK)	Gray	On top of rear cam cover
[84]	Front fuel injector	2-place Delphi 280.1 Metri-Pack Sealed (BK)	Purple	Under throttle body
[85]	Rear fuel injector	2-place Delphi 280.1 Metri-Pack Sealed (BK)	Purple	Under throttle body
[86]	Fuel pump	4-place Delphi GT 280 Sealed (BK)	Purple	Under front seat
[87]	IAC	4-place Delphi GT 150 Sealed (BK)	Gray	Throttle body
[88]	TPS	3-place Delphi GT 150 Sealed (BK)	Gray	Throttle body
[89]	IAT sensor	2-place Tyco JR. Power Timer Unsealed	Purple	Upper air-box cover
[90]	ECT sensor	2-place Delphi GT 150 Sealed (BK)	Gray	Thermostat housing
[91]	DLC	4-place Deutsch DT Sealed (GY)	Black	Under left side cover
[93]	Tail/stop lamp	4-place Tyco 070 Multilock Unsealed (BK)	Gray	Under rear seat
[94]	Rear turn signal lamp	6-place Tyco 070 Multilock Unsealed (BK) 8-place Tyco 070 Multilock Unsealed (BK) VRSCDX (DOM)	Gray	Under rear seat
[95]	Purge solenoid valve	2-place Delphi 150 Metri-Pack Sealed (R)	Gray	Below seat
[97T]	Cooling fan (top)	2-place Tyco 070 Multilock Unsealed (BK)	Gray	Under left side radiator cover
[97B]	Cooling fan (bottom)	2-place Tyco 070 Multilock Unsealed (BK)	Gray	Under left side radiator cover
[120]	Oil pressure switch	Right Angle Push On Molded terminal (BK)		In crankcase between cylinders
[121]	Rear stop lamp switch	Tyco Insulated Spade terminals (BK)	Red	Behind transmission (without ABS) Right side of ABS module (with ABS)
[122]	Horn	Flag terminals (BK)	Red	Between cylinders, left side
[128]	Starter solenoid	2-place Tyco 070 Multilock Unsealed	Gray	Under left side cover
[131]	Neutral switch	Right Angle Push On Molded terminals (BK)		Bottom rear of crankcase
[133]	JSS (HDI)	3-place Molex MX 150 Sealed (BK)	Gray	Under left radiator side cover
[137]	Rear HO2S	4-place Molex MX 150 Sealed (BK)	Gray	Under front seat

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

Table B-1. VRSC Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[138]	Front HO2S	4-place Molex MX 150 Sealed (GY)	Gray	Under radiator left side cover
[142]	Security siren (optional)	3-place Delphi GT 150 Sealed (BK)	Gray	Under rear seat
[145]	Engine sensor harness connector	8-place Molex MX 150 Sealed (BK)	Gray	Along frame
[160]	P&A battery	1-place Delphi 480 Metri-Pack Unsealed (GY)	Purple	Under passenger seat
[166]	ABS module	20-place Molex MX 150 Sealed (BK)	Breakout Box	Under right side cover
[167]	Front WSS	2-place Delphi 150 Metri-Pack Sealed (BK)	Gray	Behind radiator cover
[168]	Rear WSS	2-place Delphi 150 Metri-Pack Sealed (BK)	Gray	Along right side of frame, behind transmission
[201]	ABS diode pack	4-place Deutsch DT Sealed (BK)	Black	Under right side cover
[208]	HFSM antenna harness	4-place Deutsch DT Sealed (GY)	Black	Under passenger seat
[209]	HFSM antenna	2-place Molex MX 64 Unsealed (BK)	Light blue	Under passenger seat
[256]	Front turn signal module	4-place Deutsch DTM Sealed (GY)	Brown	Under left side cover (VRSCF)
[266]	Anti-Theft Module	4-place Delphi GT 150 Sealed (BK)	Gray	Under passenger seat
[267]	Anti-Theft Harness to Main Harness	3-place Deutsch DT Sealed (BK)	Black	Under passenger seat
Battery ground	Negative battery cable connection	Ring terminal		Front lower cam cover
[GND 1]	Harness ground	Ring terminal		Rear cylinder head
[GND 2]	Harness ground	Ring terminal		Front cylinder head

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

WIRING DIAGRAMS B.2

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table B-2.

For Solid Color Wires: See Figure B-1. The alpha code identifies wire color.

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code. For example, a trace labeled GN/Y is a green wire with a yellow stripe.

Wiring Diagram Symbols

See Figure B-1. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets []. The letter inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A and the pin symbol after a connector number identifies the pin side of the terminal connectors.

B=Socket: The letter B and the socket symbol after a connector number identifies the socket side of the terminal connectors. Other symbols found on the wiring diagrams include the following:

Diode: The diode allows current flow in one direction only in a circuit.

Wire break: The wire breaks are used to show option variances or page breaks.

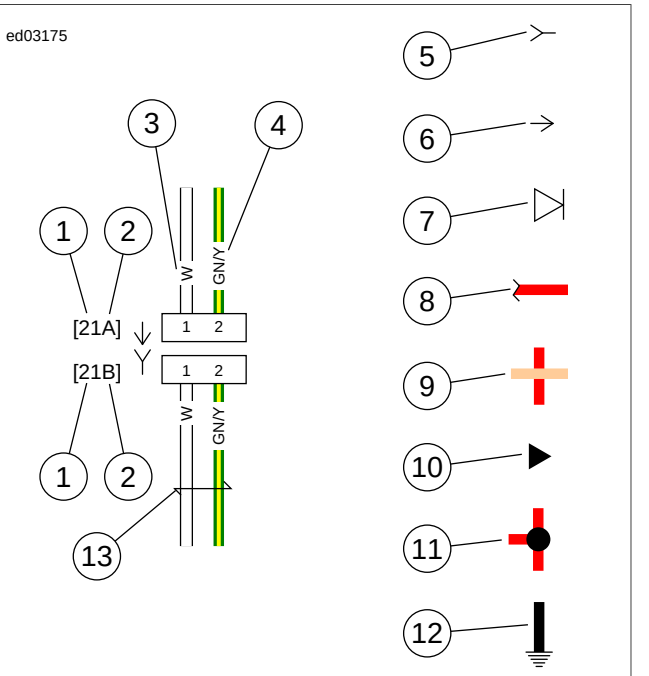
No Connection: Two wires crossing over each other in a wiring diagram that are shown with no splice indicating they are not connected together.

Circuit to/from: This symbol is used to identify there is a more complete circuit diagram on another page. The symbol is also identifying the direction of current flow.

Splice: Splices are where two or more wires are connected together along a wiring diagram. The location of the splice indicated in the wiring diagram only indicates that the wires are spliced to that circuit. It is not the true location of the splice in the actual harness.

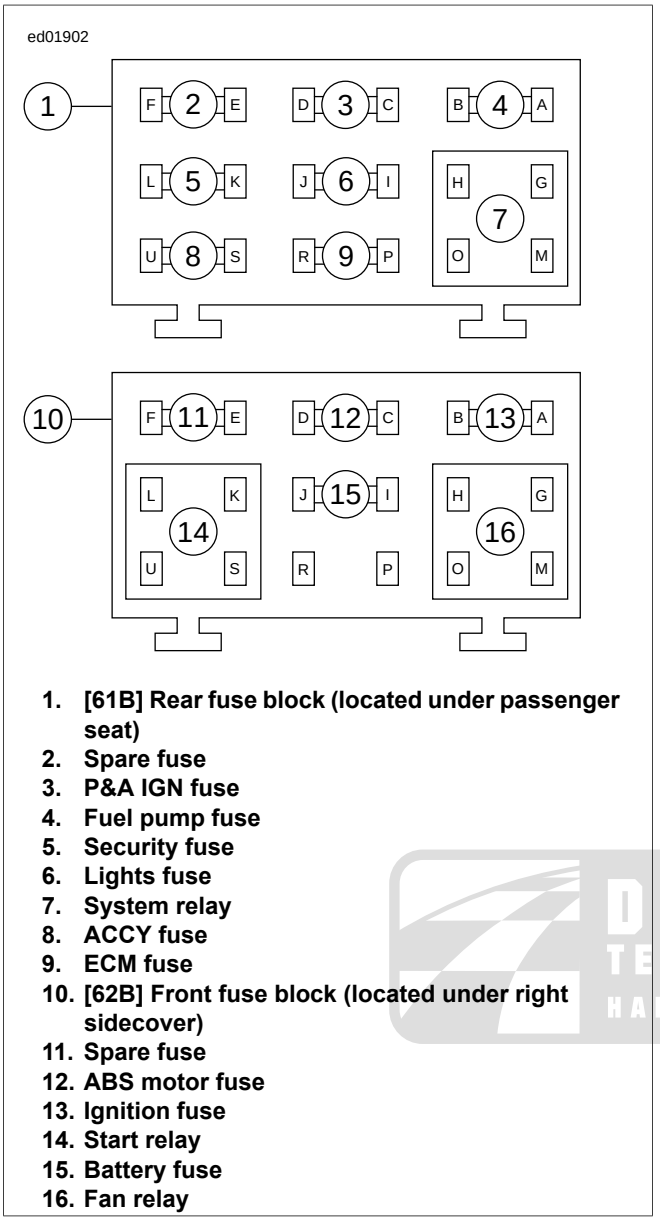
Ground: Grounds can be classified as either clean or dirty grounds. Clean grounds are identified by a (BK/GN) wire and are normally used for sensors or modules. These grounds usually do not have electric motors, coils or anything that may cause electrical interference on the ground circuit. The dirty grounds are identified by a (BK) wire and are used for components that are not as sensitive to electrical interference.

Twisted pair: This symbol indicates the two wires are twisted together in the harness. This minimizes the circuit's electromagnetic interference from external sources. If repairs are necessary to these wires they should remain as twisted wires.



1. **Connector number**
2. **Terminal code (A=pin, B=socket)**
3. **Solid wire color**
4. **Striped wire color**
5. **Socket symbol**
6. **Pin symbol**
7. **Diode**
8. **Wire break**
9. **No connection**
10. **Circuit to/from**
11. **Splice**
12. **Ground**
13. **Twisted pair**

Figure B-1. Connector/Wiring Diagram Symbols



1. **[61B] Rear fuse block (located under passenger seat)**
2. **Spare fuse**
3. **P&A IGN fuse**
4. **Fuel pump fuse**
5. **Security fuse**
6. **Lights fuse**
7. **System relay**
8. **ACCY fuse**
9. **ECM fuse**
10. **[62B] Front fuse block (located under right sidecover)**
11. **Spare fuse**
12. **ABS motor fuse**
13. **Ignition fuse**
14. **Start relay**
15. **Battery fuse**
16. **Fan relay**

Figure B-2. Fuse Block and Socket Terminals

Table B-2. Wire Color Codes

ALPHA CODE	WIRE COLOR
BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Gray
LGN	Light Green
O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

2012 VRSC WIRING DIAGRAMS

Refer to the table below for wiring diagram information.

Wiring Diagram List

DIAGRAM	LOCATION
Battery Power	Figure B-3
Ignition Power	Figure B-4
Accessory Power	Figure B-5
Chassis Grounds	Figure B-6
Sensor Grounds	Figure B-7
Headlamp	Figure B-8
Main Harness (1 of 3): 2012 VRSC with ABS	Figure B-9
Main Harness (2 of 3): 2012 VRSC without ABS	Figure B-10
Main Harness and Charging Circuit (3 of 3): 2012 VRSC	Figure B-11
Ignition Circuit: 2012 VRSC	Figure B-12
Starting Circuit: 2012 VRSC	Figure B-13
ABS Circuit: 2012 VRSC	Figure B-14
Lighting Circuit: 2012 VRSC	Figure B-15
Horn and Instrument Circuit: 2012 VRSC	Figure B-16
Security Circuit Without Anti-Theft Tracking Module: 2012 VRSC	Figure B-17
Security Circuit With Anti-Theft Tracking Module: 2012 VRSC	Figure B-18

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

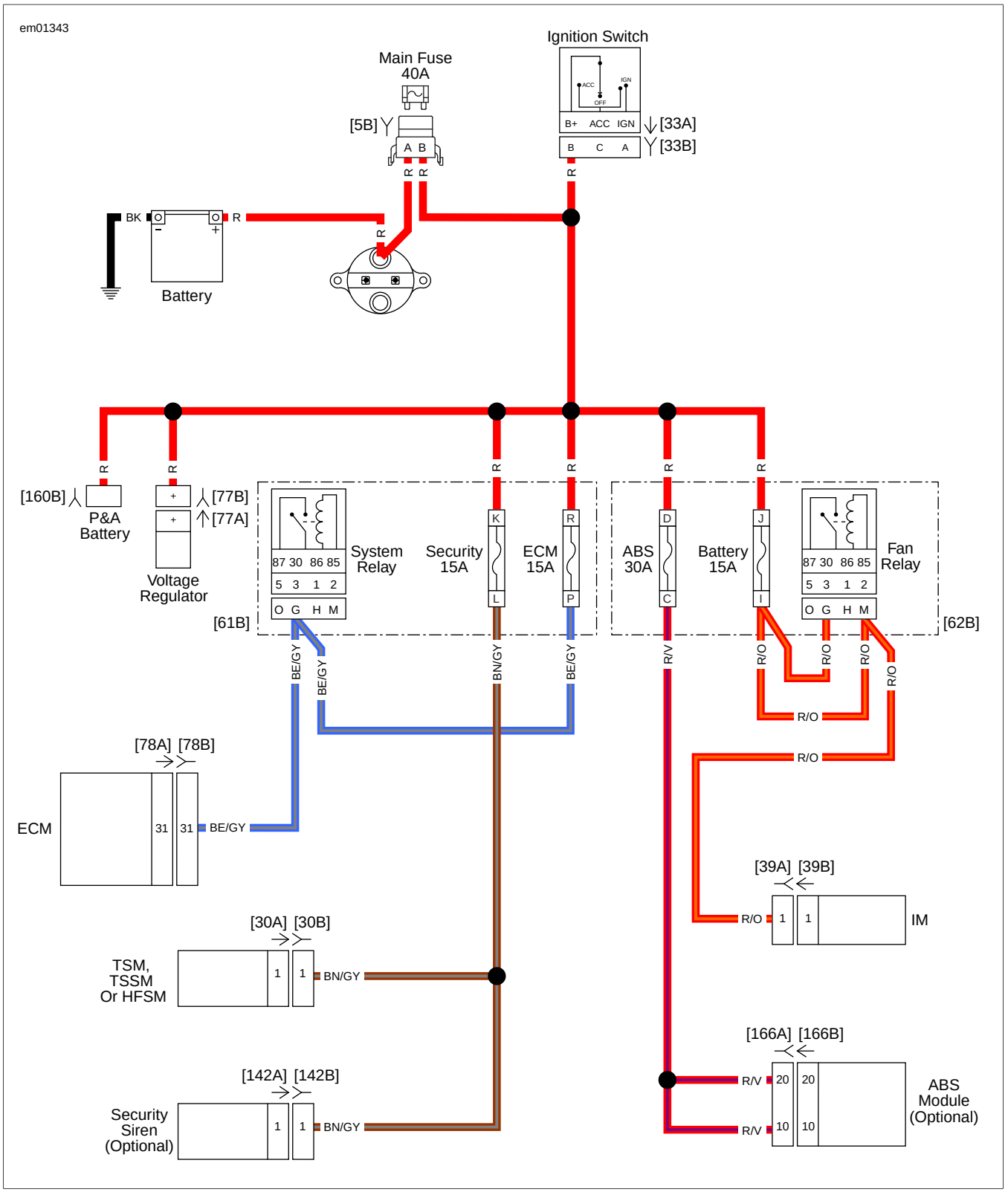


Figure B-3. Battery Power

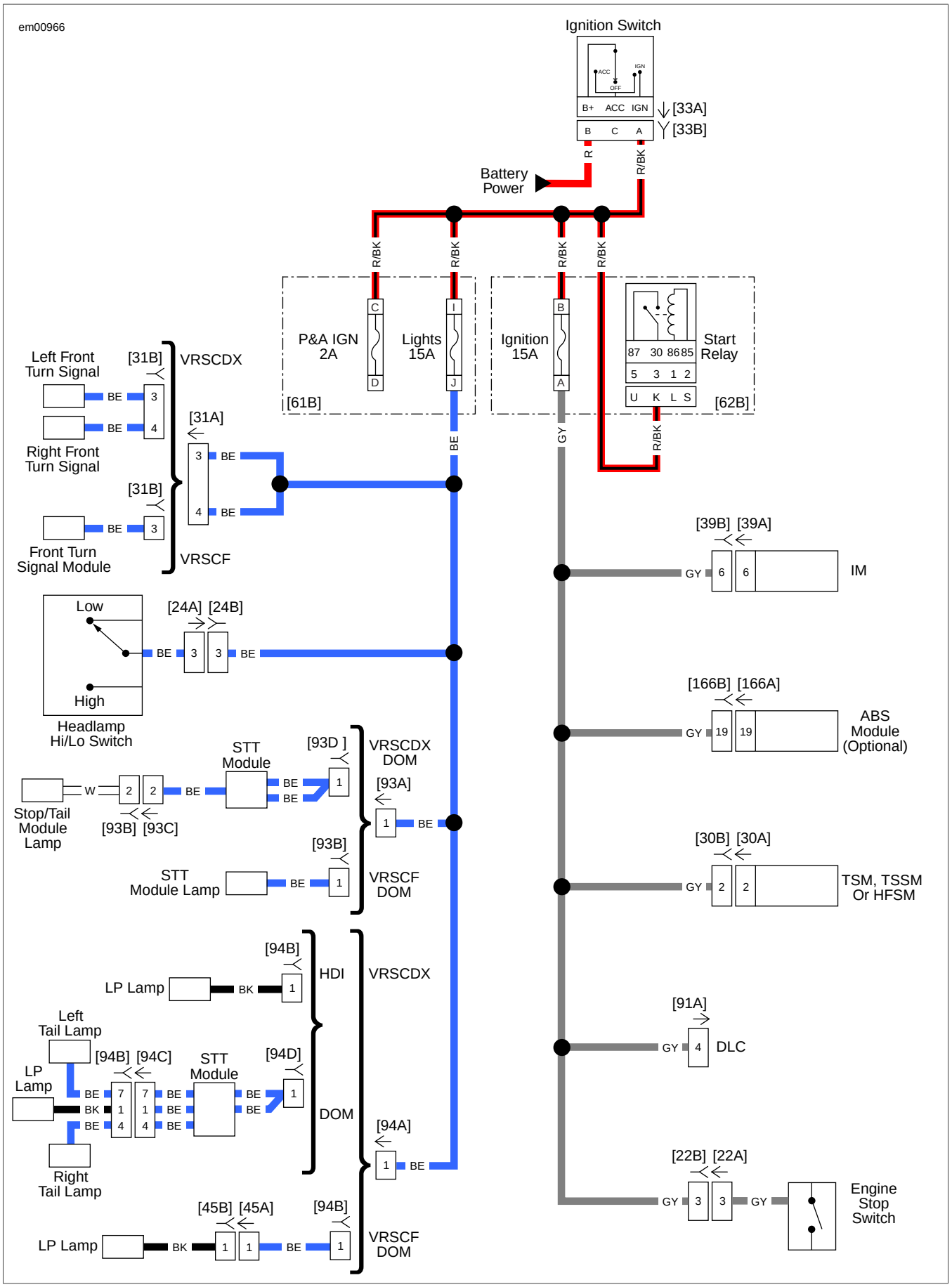


Figure B-4. Ignition Power

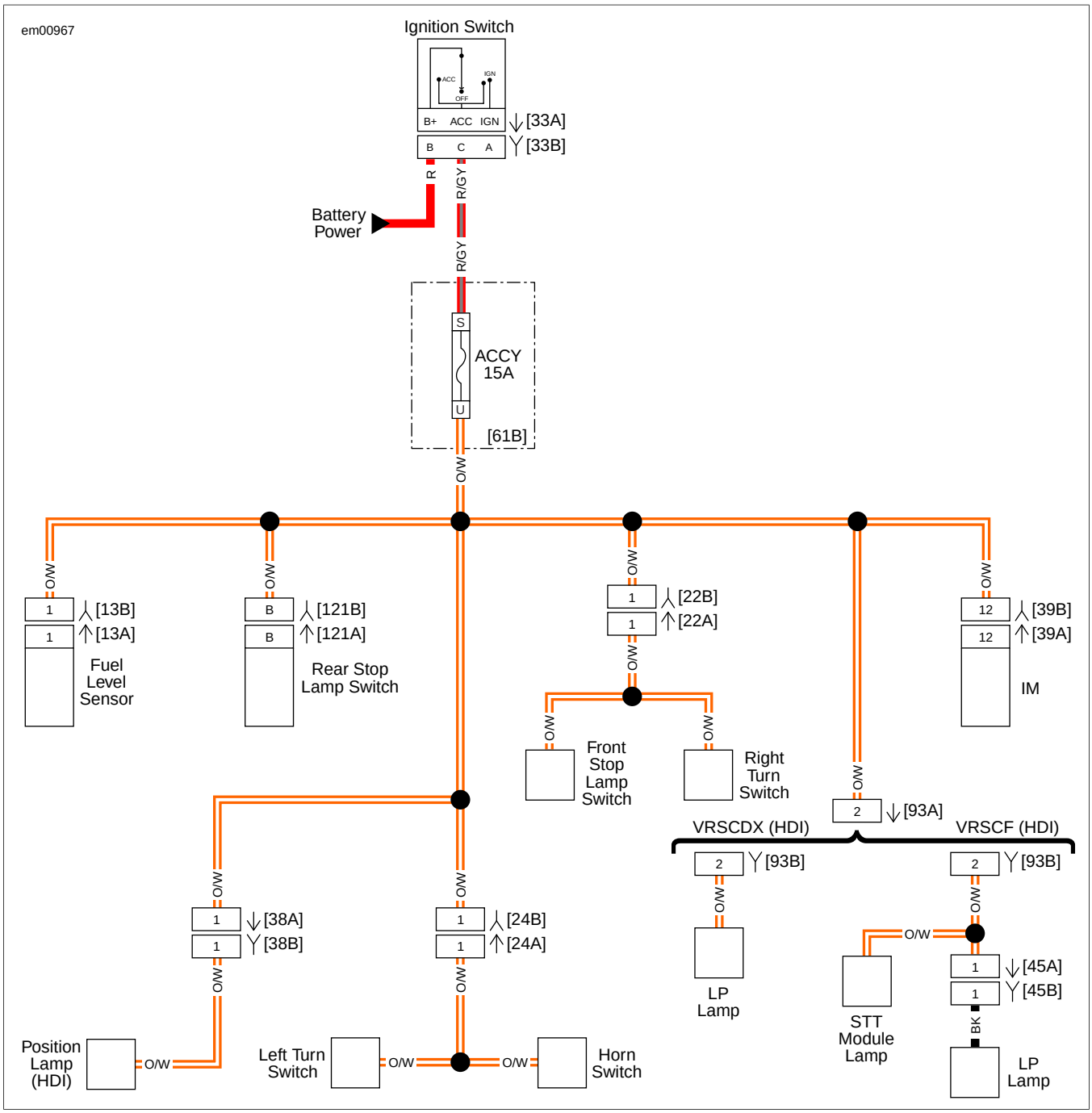


Figure B-5. Accessory Power

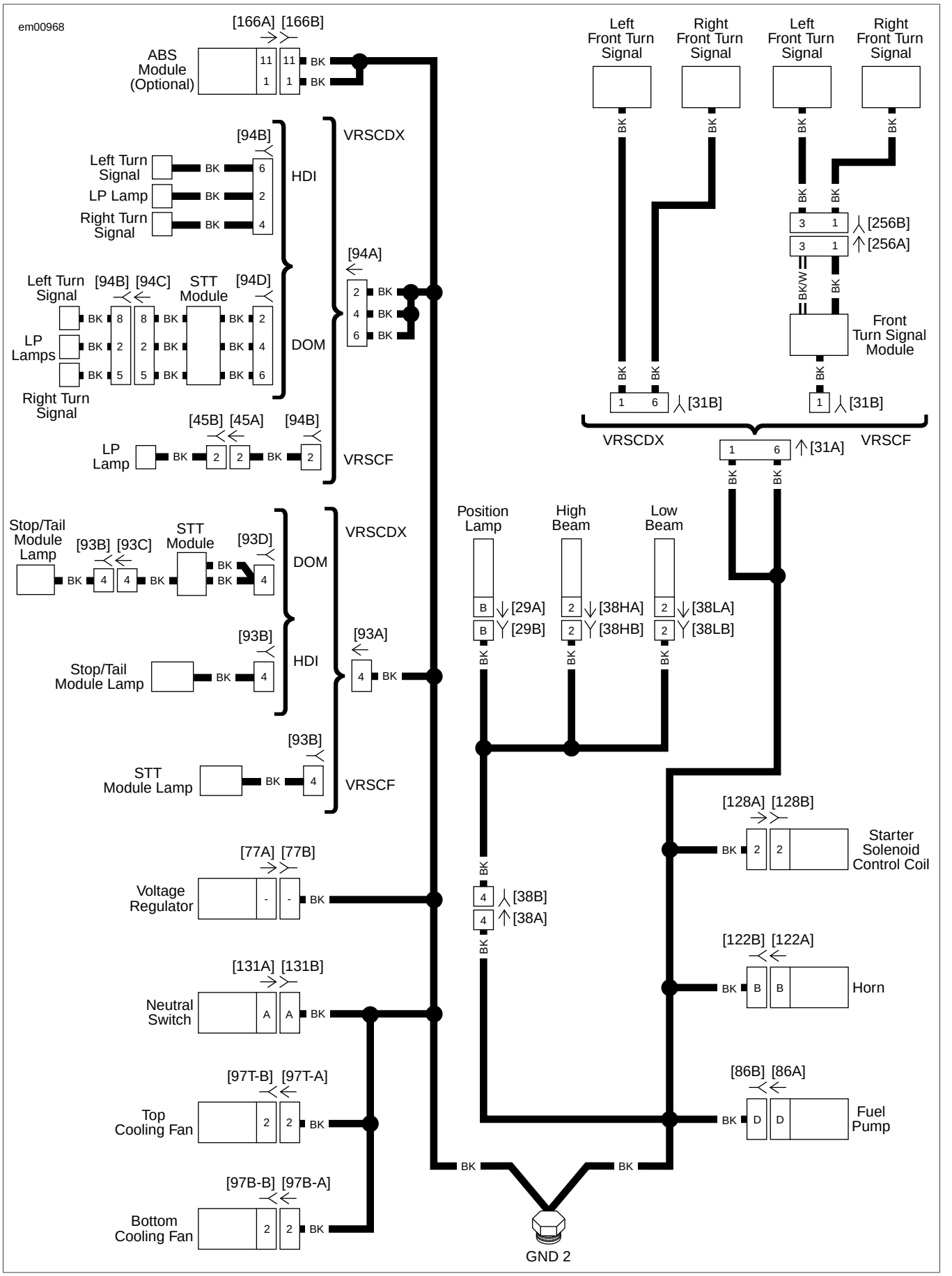


Figure B-6. Chassis Grounds

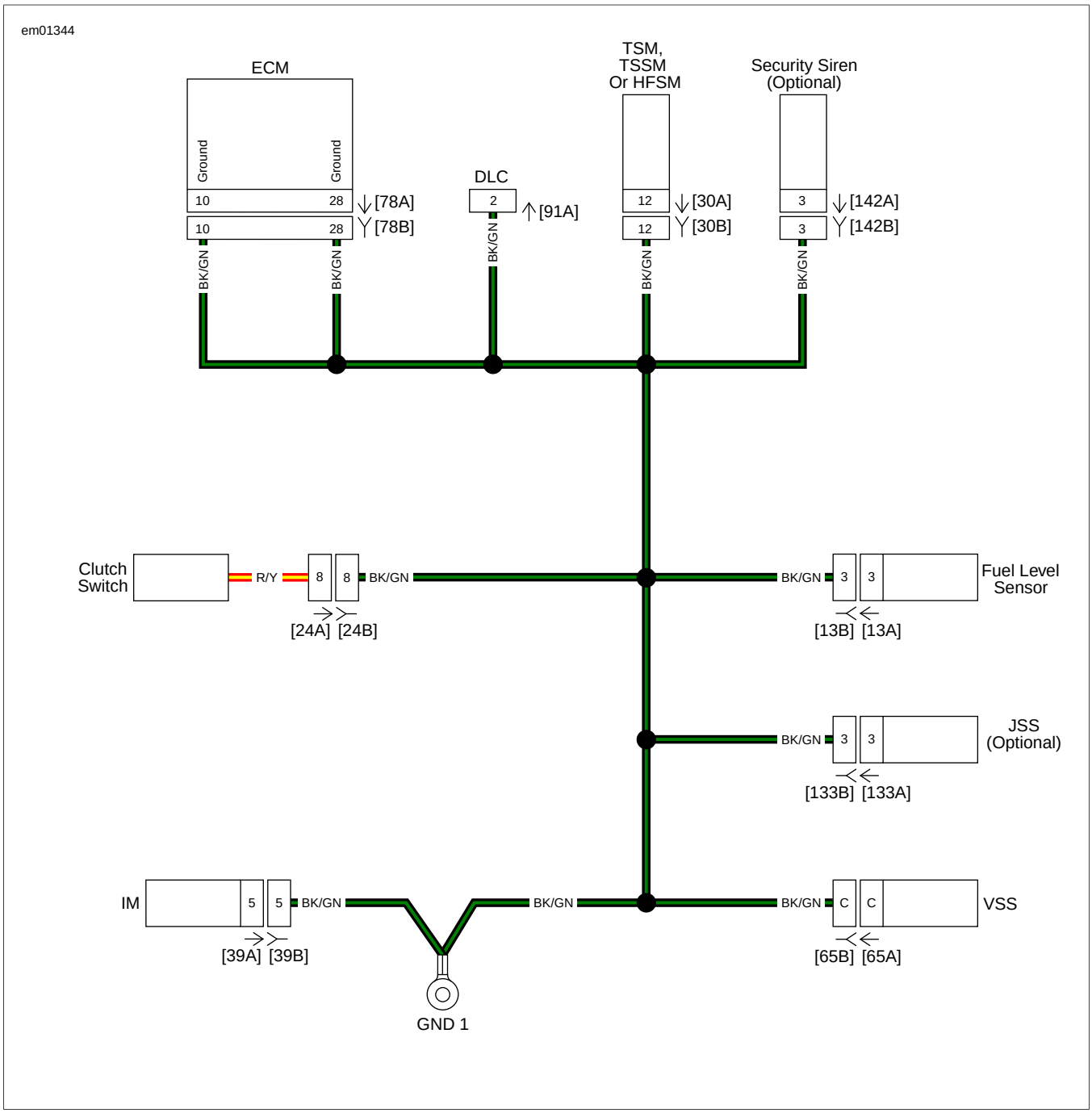


Figure B-7. Sensor Grounds

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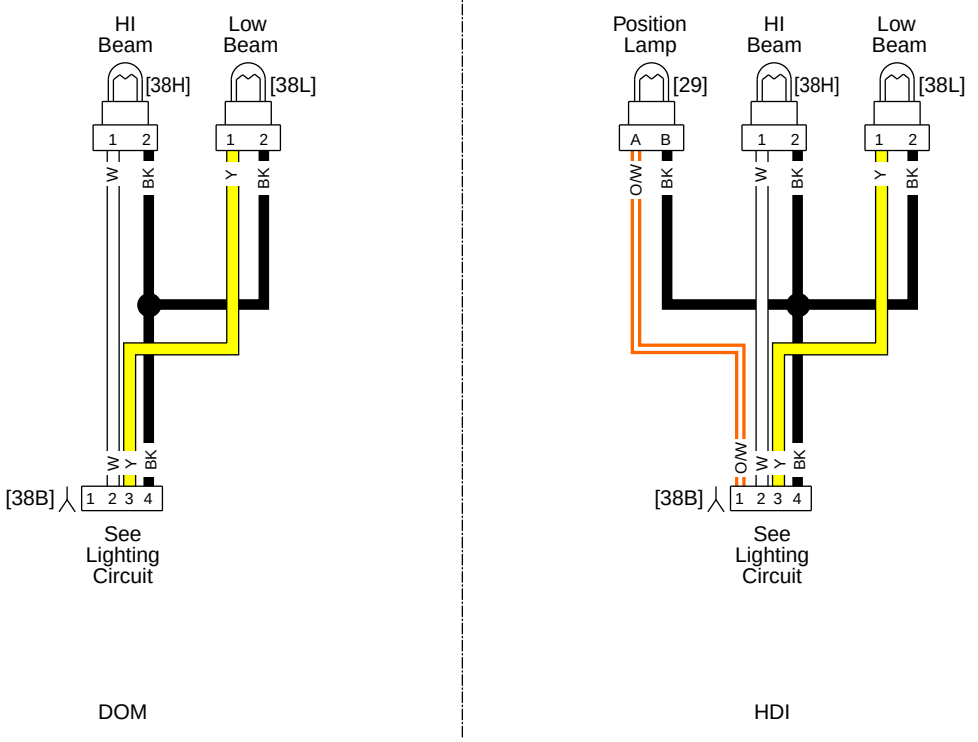


Figure B-8. Headlamp

TECHNICIAN II
HARLEY-DAVIDSON

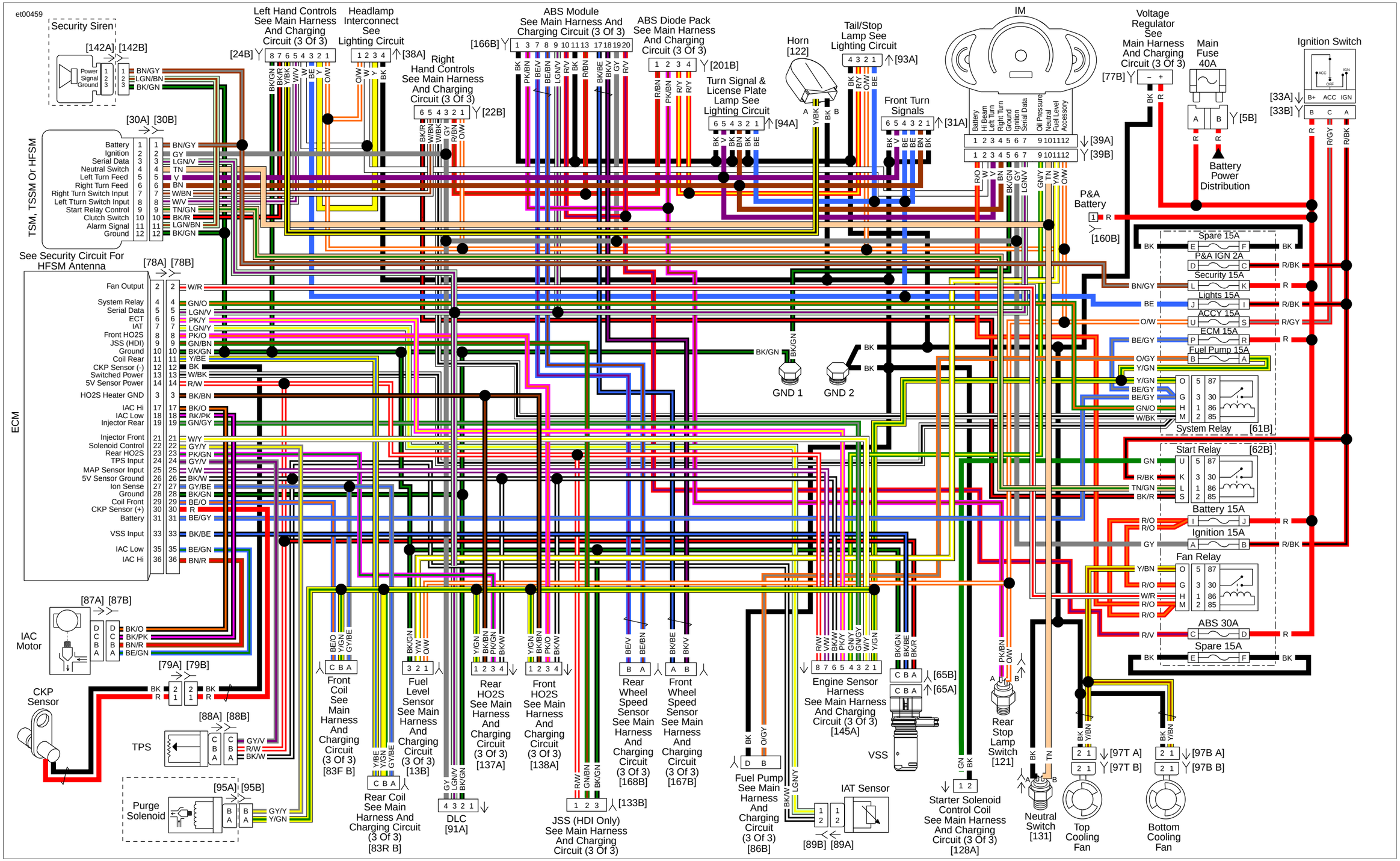


Figure B-9. Main Harness (1 of 3): 2012 VRSC with ABS

Figure B-9.
Main Harness (1 of 3): 2012 VRSC with ABS

Figure B-9.
Main Harness (1 of 3): 2012 VRSC with ABS

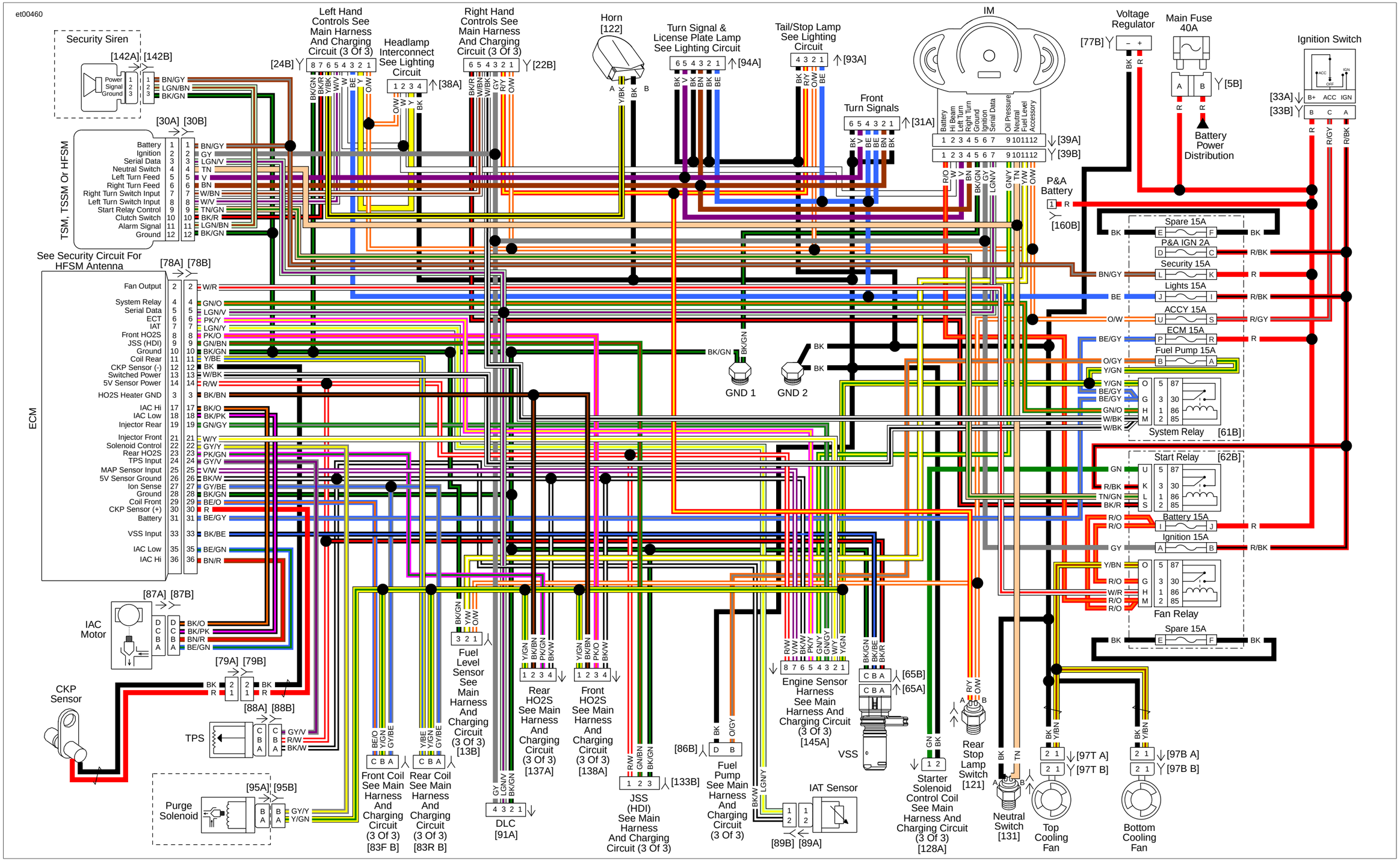


Figure B-10. Main Harness (2 of 3): 2012 VRSC without ABS

Figure B-10.
Main Harness (2 of 3): 2012 VRSC without ABS

Figure B-10.
Main Harness (2 of 3): 2012 VRSC without ABS

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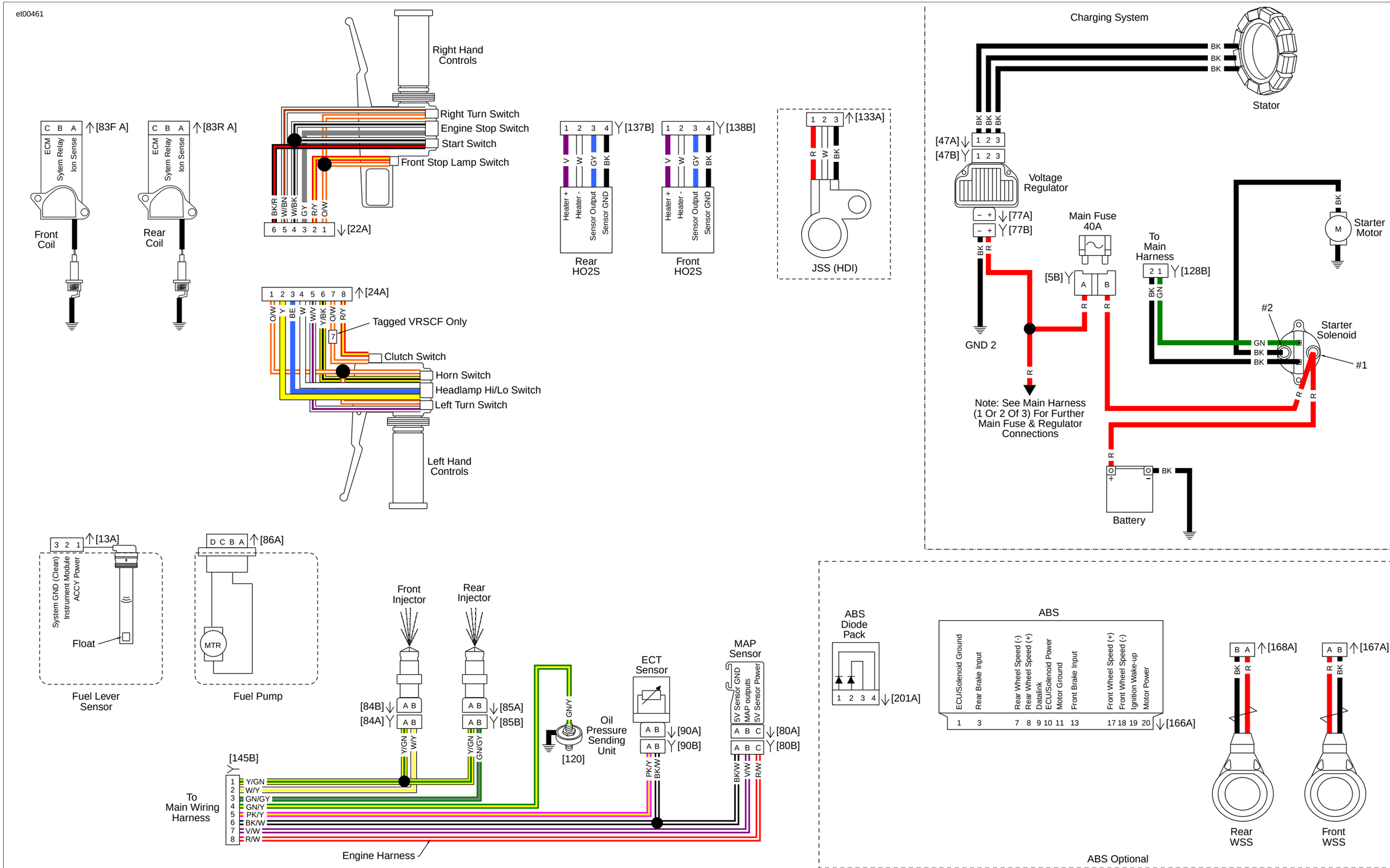


Figure B-11. Main Harness and Charging Circuit (3 of 3): 2012 VRSC

Figure B-11.
Main Harness and Charging Circuit (3 of 3): 2012 VRSC

Figure B-11.
Main Harness and Charging Circuit (3 of 3): 2012 VRSC

et00462

Right Hand Controls
Right Turn Switch
Engine Stop Switch
Start Switch
Front Stop Lamp Switch
BK/R W/BN W/BK GY O/W
[22A] 6 5 4 3 2 1
[22B] 5 4 3
W/BN W/BK GY

IM
Battery Ground Ignition Oil Pressure
1 5 6 9 [39A]
1 5 6 9 [39B]
R/O BK/GN GY GN/Y

Voltage Regulator See Main Harness And Charging Circuit (3 Of 3)
[77B] – +
BK R

Main Fuse 40A
A B [5B]
R R
Battery Power Distribution

Ignition Switch
ACC IGN OFF
B+ ACC IGN [33A]
B C A [33B]
R R/BK

TSM, TSSM Or HFSM
[30A] [30B]
Battery 1 1 BN/GY
Ignition 2 2 GY
Serial Data 3 3 LGN/V
Right Turn Switch Input 7 7 W/BN
Ground 12 12 BK/GN

See Security Circuit For HFSM Antenna
[78A] [78B]

ECM
[78A] [78B]
Fan Output 2 2 W/R
System Relay 4 4 GN/O
Serial Data 5 5 LGN/V
ECT 6 6 PK/Y
IAT 7 7 LGN/Y
Front HO2S 8 8 PK/O
JSS (HDI) 9 9 GN/BN
Ground 10 10 BK/GN
Coil Rear 11 11 Y/BE
CKP Sensor (-) 12 12 BK
Switched Power 13 13 W/BK
5V Power 14 14 R/W
HO2S Heater GND 3 3 BK/BN
IAC Hi 17 17 BK/O
IAC Low 18 18 BK/PK
Injector Rear 19 19 GN/GY
Injector Front 21 21 W/Y
Solenoid Control 22 22 GY/Y
Rear HO2S 23 23 PK/GN
TPS Input 24 24 GY/V
MAP Sensor Input 25 25 V/W
5V Sensor Ground 26 26 BK/W
Ion Sense 27 27 GY/BE
Ground 28 28 BK/GN
Coil Front 29 29 BE/O
CKP Sensor (+) 30 30 R
Battery 31 31 BE/GY
VSS Input 33 33 BK/BE
IAC Low 35 35 BE/GN
IAC Hi 36 36 BN/R

BK/GN
GND 1
GND 2
BK
BK

P&A Battery
R
[160B]
[61B]

Security 15A
BN/GY L K R

ECM 15A
BE/GY P R R

Fuel Pump 15A
O/GY B A

System Relay
Y/GN BE/GY BE/GY GN/O W/BK
O 5 87
G 3 30
H 1 86
M 2 85

Battery 15A
R/O R/O I J R

Ignition 15A
GY A B R/BK

Fan Relay
Y/BN R/O W/R R/O R/O
O 5 87
G 3 30
H 1 86
M 2 85
[62B]

[97B A] [97B B]
Y/BN BK
Bottom Cooling Fan

[97T A]
[97T B]
Top Cooling Fan

[87A] [87B]
IAC Motor
D C B A
BK/O BK/PK BN/R BE/GN

[79A] [79B]
CKP Sensor
BK R
2 1
BK R

[88A] [88B]
TPS
C B A
GY/V R/W BK/W

[95A] [95B]
Purge Solenoid
B A
GY/Y Y/GN

R/W BK/R

BE/O Y/GN G Y/BE
C B A
Front Coil See Main Harness And Charging Circuit (3 Of 3) [83F B]

Y/BE Y/GN G Y/BE
C B A
Rear Coil See Main Harness And Charging Circuit (3 Of 3) [83R B]

GY LGN/V BK/GN
4 3 2
DLC [91A]

Y/GN BK/BN PK/GN BK/W
1 2 3 4
Rear HO2S See Main Harness And Charging Circuit (3 Of 3) [137A]

Y/GN BK/BN PK/O BK/W
1 2 3 4
Front HO2S See Main Harness And Charging Circuit (3 Of 3) [138A]

R/W GN/BN BK/GN
1 2 3
JSS (HDI Only) See Main Harness And Charging Circuit (3 Of 3) [133B]

BK O/GY
D B
Fuel Pump See Main Harness And Charging Circuit (3 Of 3) [86B]

R/W V/W BK/W PK/Y GN/Y GN/GY W/Y Y/GN
8 7 6 5 4 3 2 1
Engine Sensor Harness See Main Harness And Charging Circuit (3 Of 3) [145A]

BK/GN BK/BE BK/R
C B A [65B]
C B A [65A]
VSS

LGN/Y BK/W
1 2
IAT Sensor
[89B] [89A]

Figure B-12. Ignition Circuit: 2012 VRSC

Figure B-12.
Ignition Circuit: 2012 VRSC

Figure B-12.
Ignition Circuit: 2012 VRSC

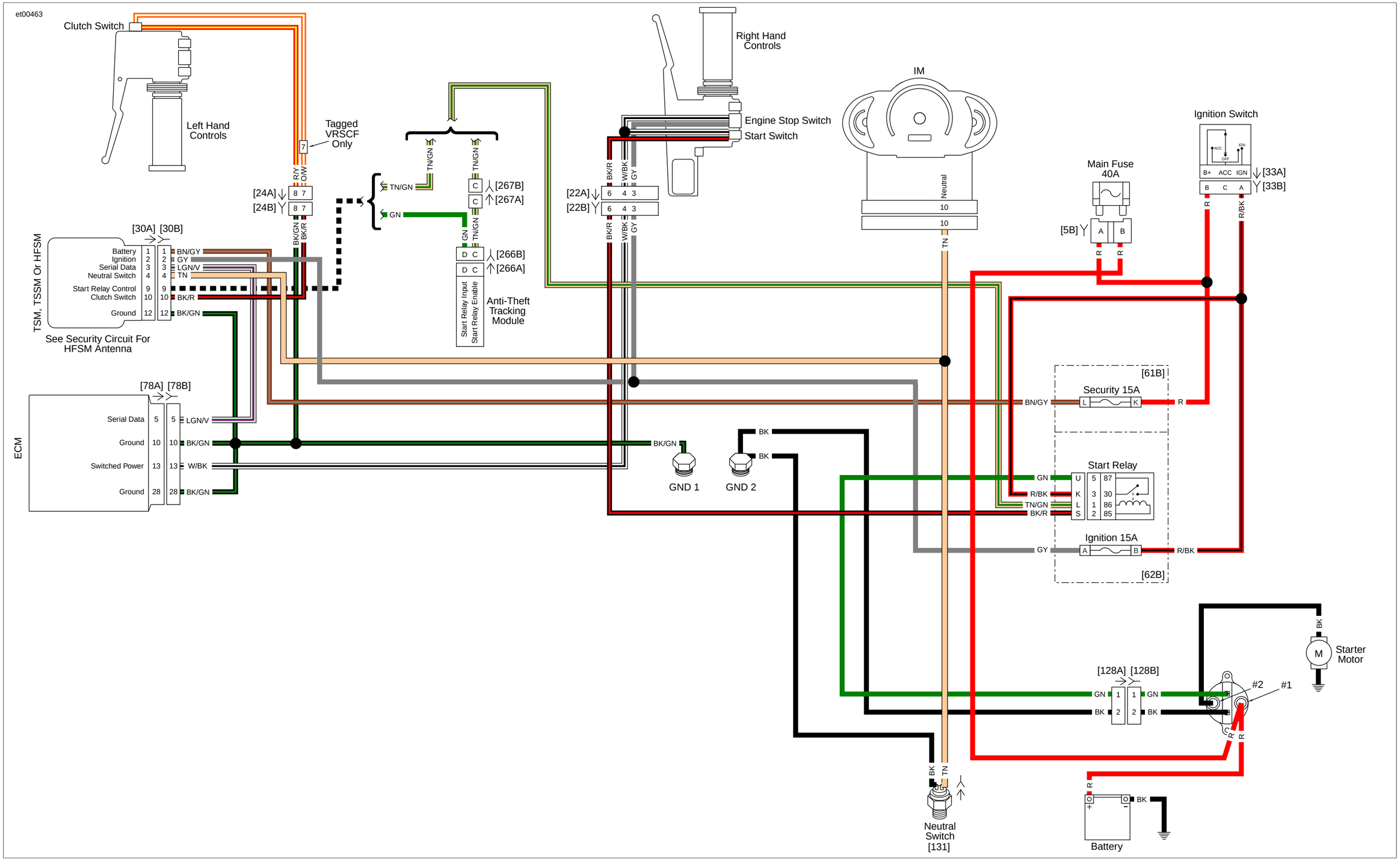


Figure B-13. Starting Circuit: 2012 VRSC

Figure B-13.
Starting Circuit: 2012 VRSC

Figure B-13.
Starting Circuit: 2012 VRSC

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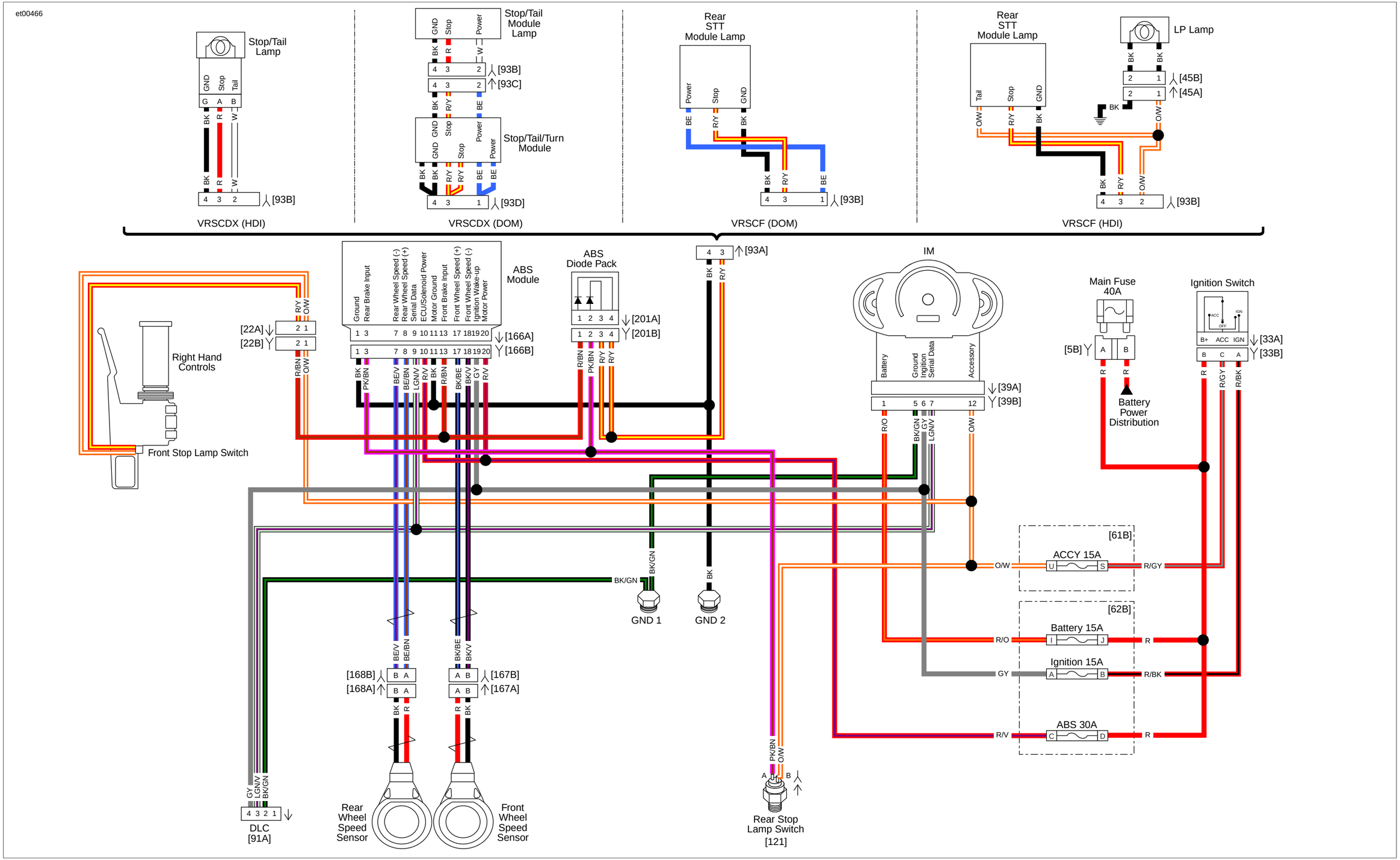


Figure B-14. ABS Circuit: 2012 VRSC

Figure B-14.
ABS Circuit: 2012 VRSC

Figure B-14.
ABS Circuit: 2012 VRSC

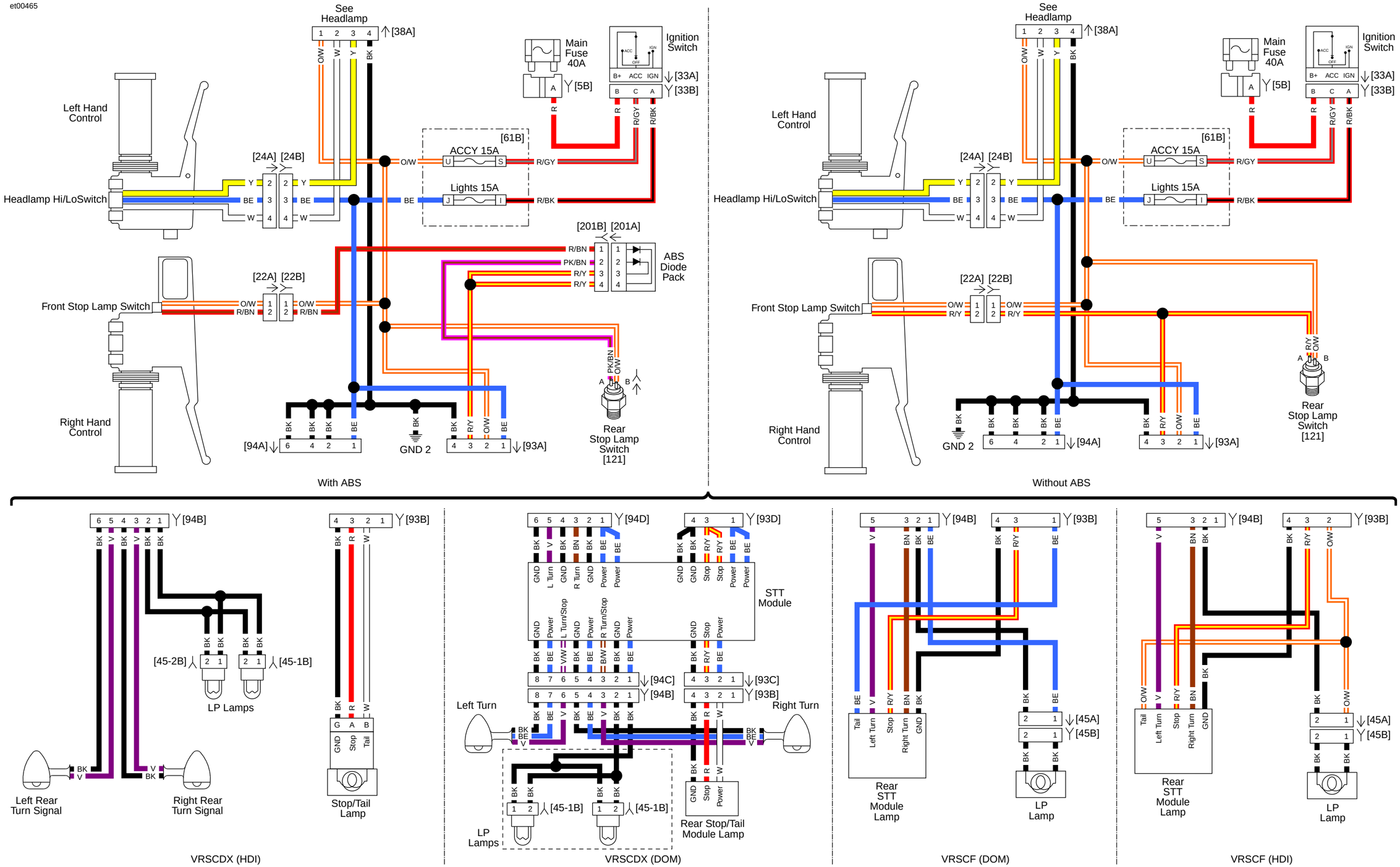


Figure B-15. Lighting Circuit: 2012 VRSC

Figure B-15.
Lighting Circuit: 2012 VRSC

Figure B-15.
Lighting Circuit: 2012 VRSC

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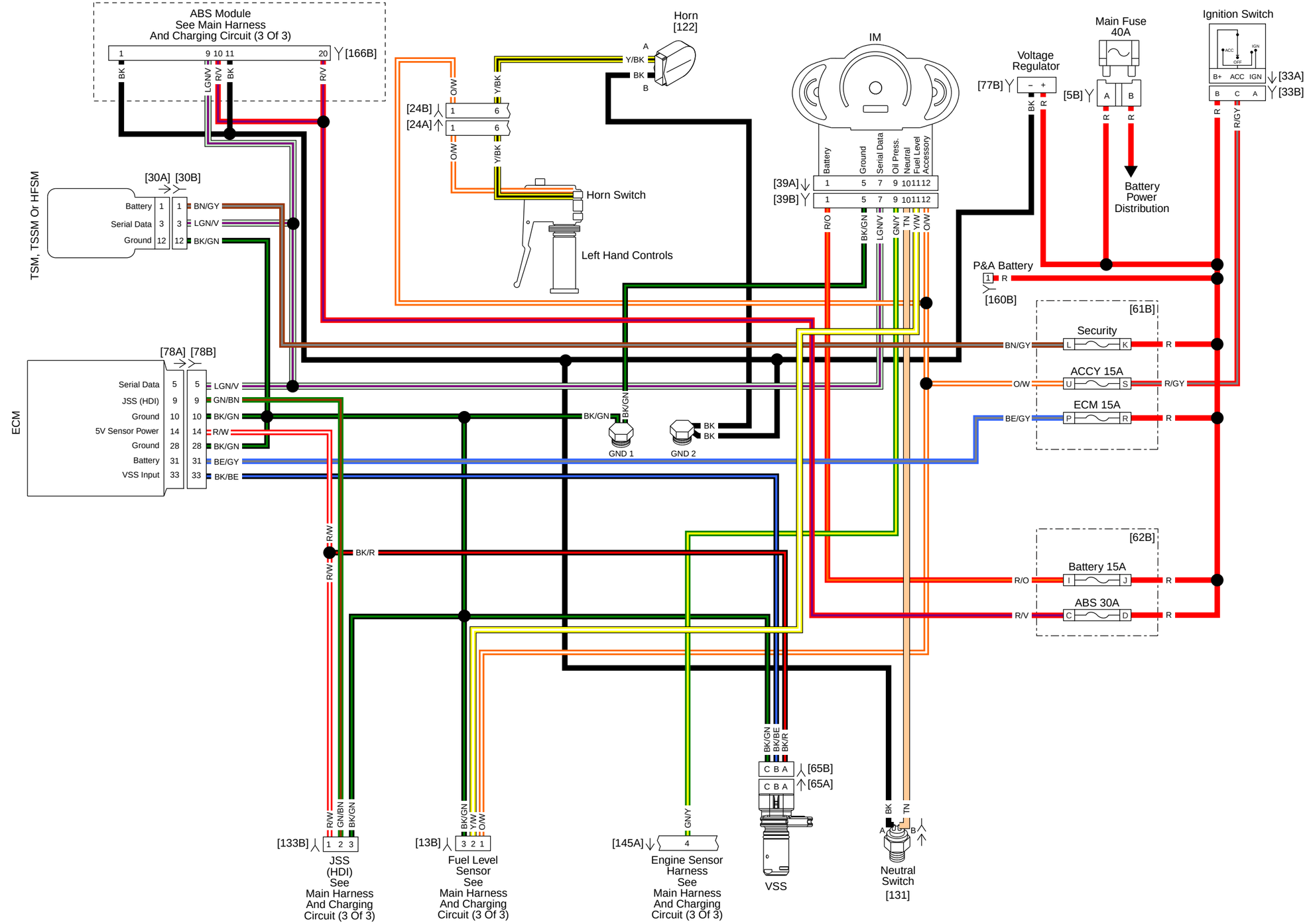


Figure B-16. Horn and Instrument Circuit: 2012 VRSC

Figure B-16.
Horn and Instrument Circuit: 2012 VRSC

Figure B-16.
Horn and Instrument Circuit: 2012 VRSC

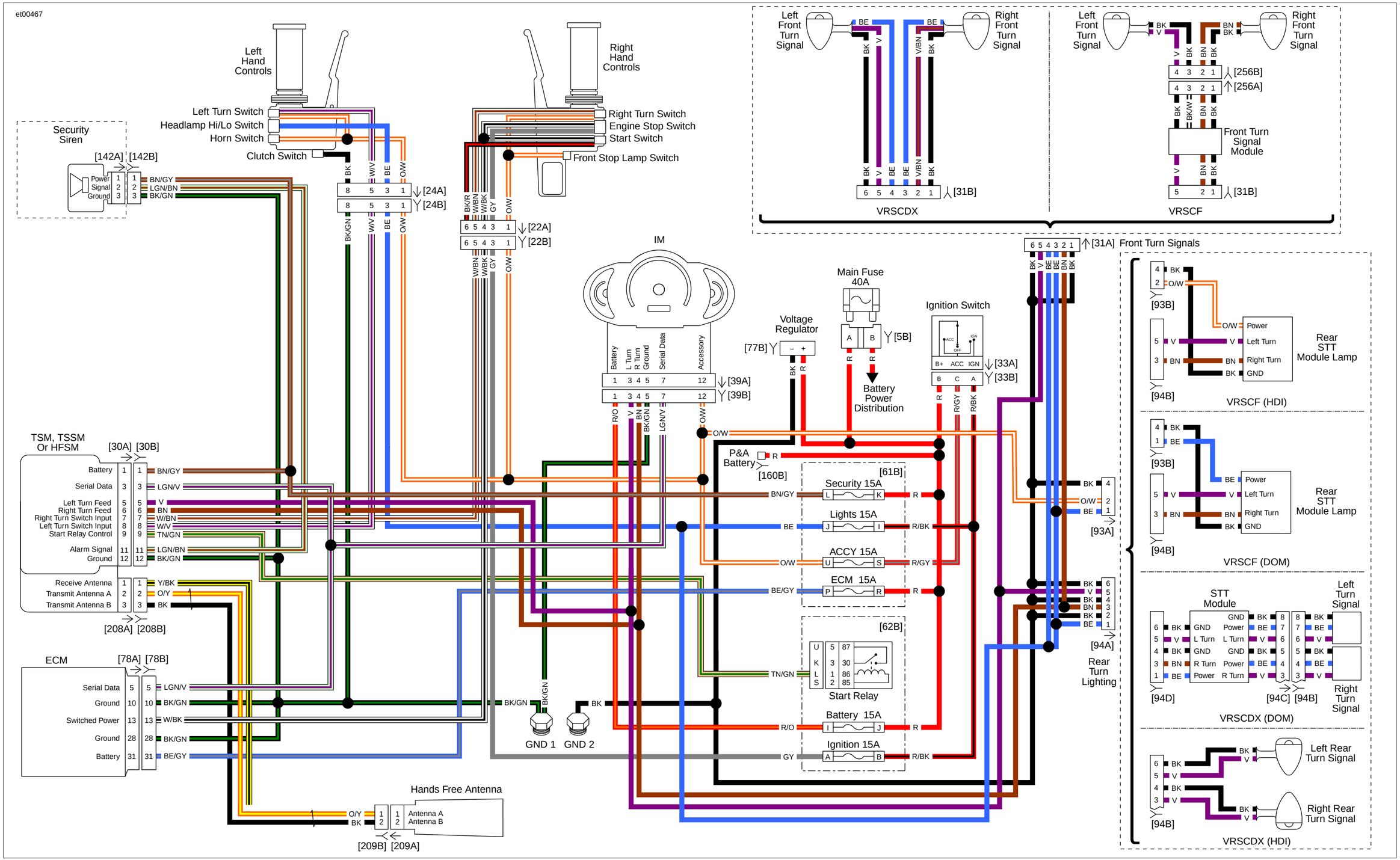


Figure B-17. Security Circuit Without Anti-Theft Tracking Module: 2012 VRSC

Figure B-17.
Security Circuit Without Anti-Theft Tracking Module: 2012 VRSC

Figure B-17.
Security Circuit Without Anti-Theft Tracking Module: 2012 VRSC

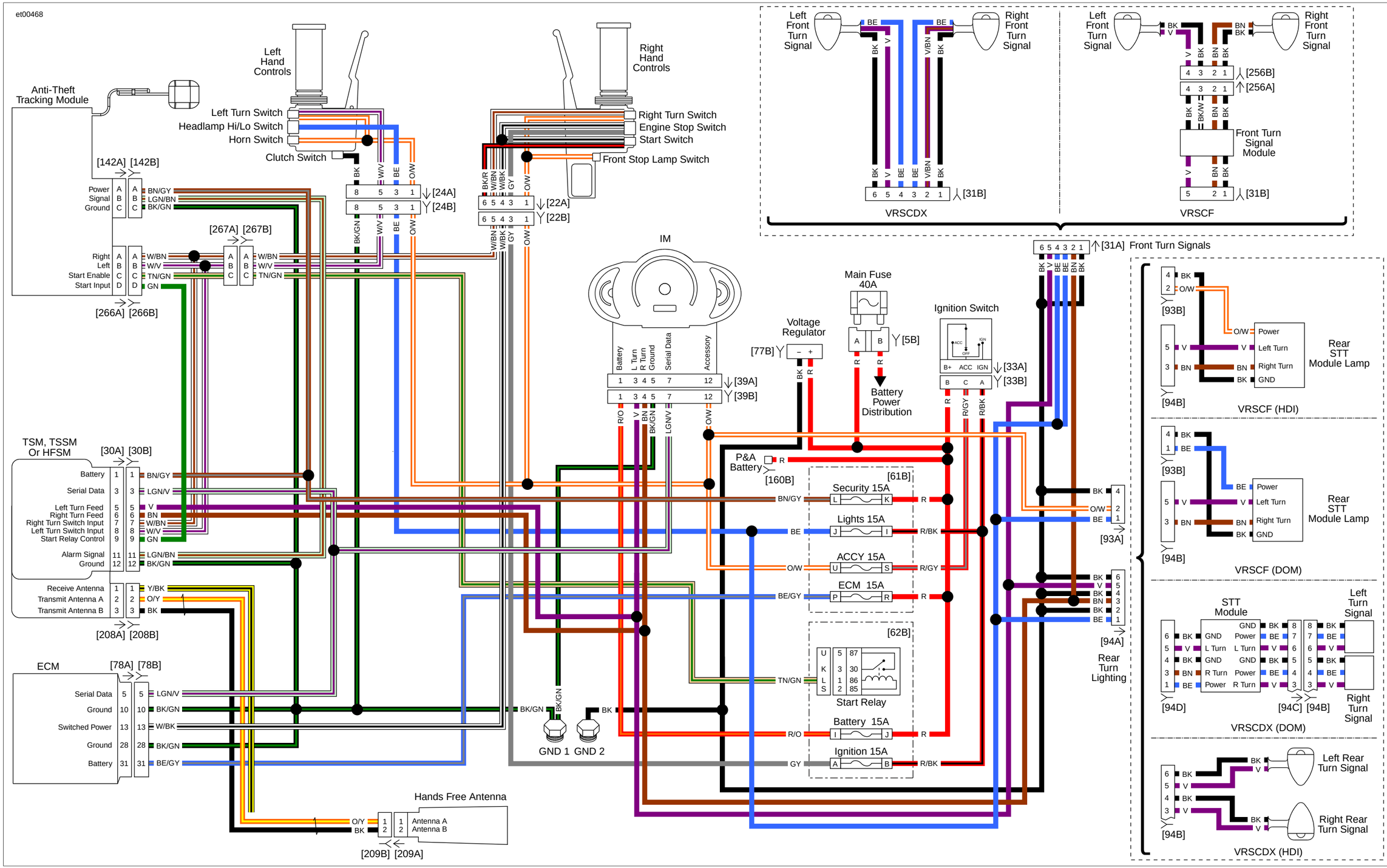


Figure B-18. Security Circuit With Anti-Theft Tracking Module: 2012 VRSC

Figure B-18.
Security Circuit With Anti-Theft Tracking Module: 2012 VRSC

Figure B-18.
Security Circuit With Anti-Theft Tracking Module: 2012 VRSC

TABLE OF CONTENTS

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C.1 FASTENER TORQUE VALUES	C-1
C.2 ABS MODULE	C-2
C.3 WHEEL SPEED SENSOR	C-5
C.4 ABS BRAKE LINES	C-8

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

NOTES

FASTENER TORQUE VALUES C.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
ABS module fasteners	4-6 Nm	35-53 **in-lbs**	C.2 ABS MODULE, ABS Module Service
ABS module fasteners	4-6 Nm	35-53 **in-lbs**	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
Banjo bolt to ABS module	17.0-20.0 Nm	13.0-14.7 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Banjo bolt to calipers	23-29 Nm	17-21.4 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Banjo bolt to master cylinder	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
Banjo bolt to master cylinder	23-29 Nm	17-21.4 ft-lbs	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module
Bleeder screws	23.0-26.0 Nm	17.0-19.2 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
Brake line clamp fastener (to frame)	6-10 Nm	53.1-88.4 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Screw	6-10 Nm	53.0-88.4 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers

ABS MODULE C.2

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

NOTICE

This device is sensitive to electrostatic discharge (ESD). To prevent damage to the device, always touch the motorcycle frame or a grounded surface before handling. (00588c)

NOTE

The ABS module consists of the hydraulic control unit (HCU) and the electronic control unit (ECU) which can be serviced separately. ABS module must be removed from motorcycle for service.

1. Remove main fuse, left side cover and right side cover. See 7.6 MAIN FUSE
2. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
3. Disconnect battery. Remove all clipped connectors from battery caddy. Disconnect and remove starter solenoid. See 1.24 BATTERY MAINTENANCE.
4. See Figure C-1. Remove battery and tray components from motorcycle.
 a. Remove strap (1).
 b. Remove battery (6) from motorcycle.
 c. Remove left side battery caddy (5) and right side battery caddy (11).
 d. Remove fasteners (7, 8) and remove battery tray (9) from motorcycle.
5. Remove radiator side panels. See 1.16 RADIATOR SIDE COVERS.
6. Remove fasteners and washers on each side of radiator cover. Remove radiator cover.

NOTE

Cover any remaining painted areas to protect them from contact with brake fluid during the removal and installation procedures.

7. See Figure C-2. Remove top left mount bracket (3) from battery tray floor.
8. Evacuate brake fluid from brake system.
9. See Figure C-3. Disconnect ABS module electrical connector.

NOTE

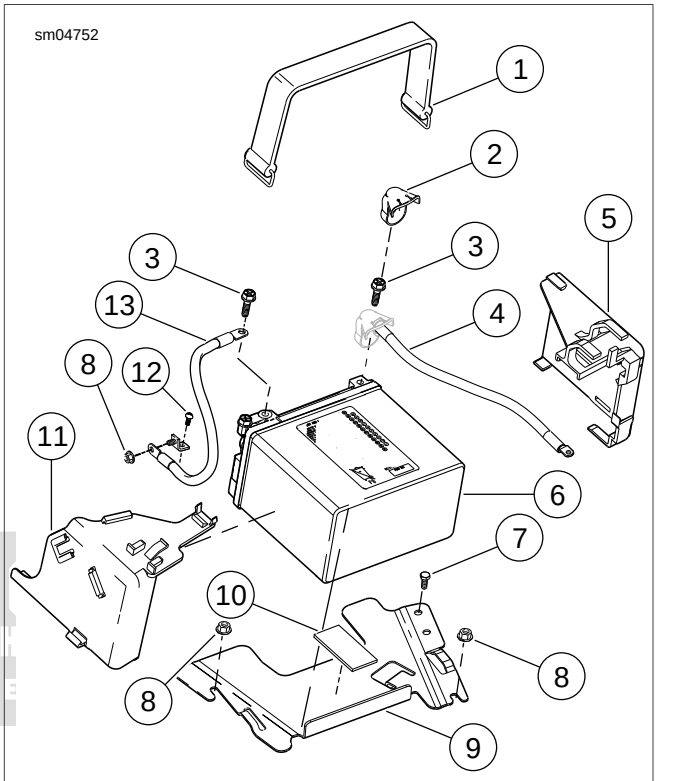
Note location and routing of all brake lines as they attach to ABS module.

10. Remove all brake lines from ABS module.

NOTE

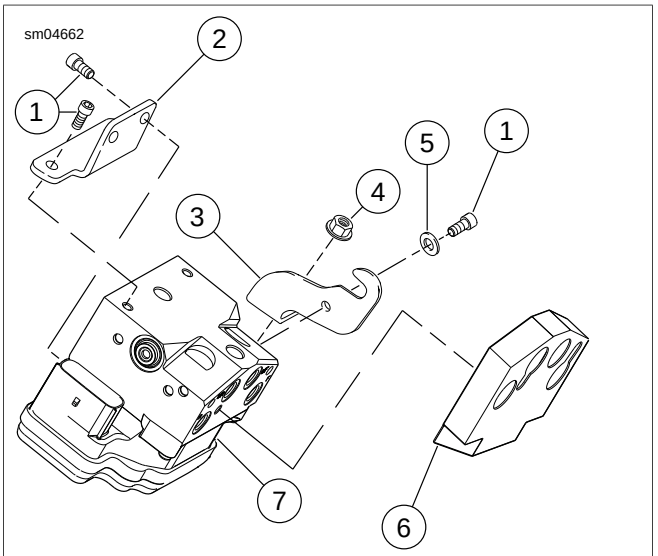
Wrap banjo fittings with shop towels to absorb residual brake fluid leakage.

11. See Figure C-2. Remove screws (1) and ABS top mount bracket (2) from ABS module.
12. Remove ABS module from motorcycle.



1. **Strap**
2. **Boot**
3. **Terminal screw (2)**
4. **Positive cable to solenoid**
5. **Battery caddy (left side)**
6. **Battery**
7. **Screw**
8. **Nut (3)**
9. **Battery tray**
10. **Battery tray pad**
11. **Battery caddy (right side)**
12. **Screw**
13. **Negative cable**

Figure C-1. Battery and Tray Components



1. **Screw (5)**
2. **ABS top mount bracket**
3. **ABS left mount bracket**
4. **Nut**
5. **Washer**
6. **ABS module cover**
7. **ABS module**

Figure C-2. ABS Module

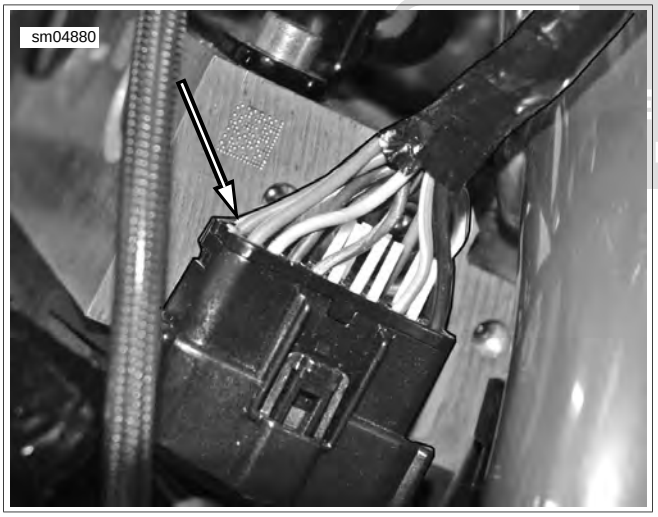


Figure C-3. ABS Module Plug

ABS MODULE SERVICE

FASTENER	TORQUE VALUE	
ABS module fasteners	4-6 Nm	35-53 **in-lbs**

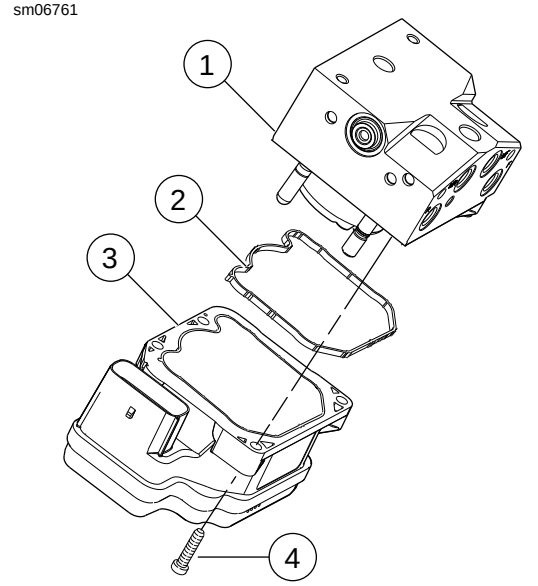
NOTICE

This device is sensitive to electrostatic discharge (ESD). To prevent damage to the device, always touch the motorcycle frame or a grounded surface before handling. (00588c)

NOTES

- *The ABS module consists of the hydraulic control unit (HCU) and the electronic control unit (ECU) which can be serviced separately.*
- *ABS module must be removed from motorcycle for service.*

1. See Figure C-4. With ABS module removed from motorcycle, remove four fasteners (4) and separate ECU (3) from HCU (1).
2. Replace damaged or worn HCU or ECU.
3. Clean ECU to HCU mounting surface with a clean shop rag.
4. Install **new** gasket (2) to ECU (3).
5. Secure ECU to HCU using four fasteners (4). Tighten fasteners in a criss cross pattern to 4-6 Nm (35-53 **in-lbs**).



1. **Hydraulic control unit (HCU)**
2. **Gasket**
3. **Electrical control unit (ECU)**
4. **Fastener (4)**

Figure C-4. ABS Module Components

ABS DIODE SERVICE

NOTICE

This device is sensitive to electrostatic discharge (ESD). To prevent damage to the device, always touch the motorcycle frame or a grounded surface before handling. (00588c)

1. Remove left side cover.
2. See Figure C-5. Remove ABS diode from connector.
3. Install **new** ABS diode in connector.
4. Replace left side cover.



Figure C-5. ABS Diode Location

INSTALLATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

NOTICE

This device is sensitive to electrostatic discharge (ESD). To prevent damage to the device, always touch the motorcycle frame or a grounded surface before handling. (00588c)

1. See Figure C-2. Insert ABS module into head cavity of motorcycle frame.
2. Loosely install all ABS module fasteners. Do not tighten fasteners at this time.

NOTE

Connect brake lines to ABS module at correct ports exactly as noted upon disassembly.

3. Using **new** sealing washers, attach brake lines to ABS module at correct ports exactly as noted upon disassembly. Tighten banjo bolts to 17-20 Nm (12.5-14.7 ft-lbs).
4. Final tighten ABS module fasteners to 4-6 Nm (35-53 **in-lbs**).
5. See Figure C-1. Install battery tray components and battery.
 a. Insert battery tray (9) into frame.
 b. Install battery tray with nuts (8) and fastener (7) as shown. Tighten fasteners to 6-10 Nm (53-88 **in-lbs**).
 c. Install left side battery caddy (5), right side battery caddy (11), battery (6) and strap (1).
 d. See Figure C-3. Connect ABS module plug to ABS module.
6. Install starter solenoid to battery tray. See 7.11 STARTER SOLENOID.
7. Connect starter solenoid cables and wire.
8. Connect battery.
9. Install all clipped connectors to their original positions on battery tray.
10. Install main fuse.
11. Install air cleaner assembly.
12. Fill and bleed air from brake system.

⚠WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

13. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool. Add brake fluid and bleed brake system.
14. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that brake system is both properly connected and bled.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

WHEEL SPEED SENSOR C.3

FRONT WHEEL SPEED SENSOR

Removal

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove both radiator side covers. See 1.16 RADIATOR SIDE COVERS.
3. Remove fasteners and washers on each side of radiator cover. Remove radiator cover.
4. Remove front axle nut and slide axle out far enough for wheel speed sensor to be removed. See 2.25 FRONT WHEEL.
5. See Figure C-6. Remove ABS sensor cable clip (1) from bracket (2).
6. See Figure C-7. Locate hose clips and disconnect sensor cable from brake hose.
7. See Figure C-9. Disconnect ABS connector and remove wheel speed sensor from motorcycle.

Installation

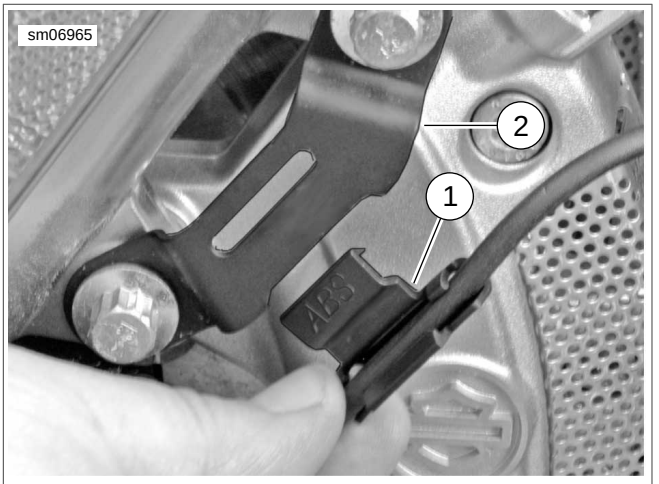
NOTES

- *Never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

1. Install wheel speed sensor, slide front axle into place and pivot wheel speed sensor upward until tab stops sensor on fork leg.
2. Tighten front axle nut according to procedure. See 2.25 FRONT WHEEL.
3. See Figure C-6. Install ABS sensor clip as shown.
4. See Figure C-9. Connect ABS wheel speed sensor connector.
5. See Figure C-8. Attach cable strap (1) to secure ABS sensor wiring (2) to brake line (3).
6. See Figure C-7. Install ABS cable clips as shown.
7. Install both radiator side covers. See 1.16 RADIATOR SIDE COVERS.
8. Install fasteners and washers on each side of radiator cover. Remove radiator cover.
9. Install main fuse. See 7.6 MAIN FUSE.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **ABS Sensor Cable Clip**
2. **ABS Sensor Cable Clip Bracket**

Figure C-6. ABS Sensor Cable

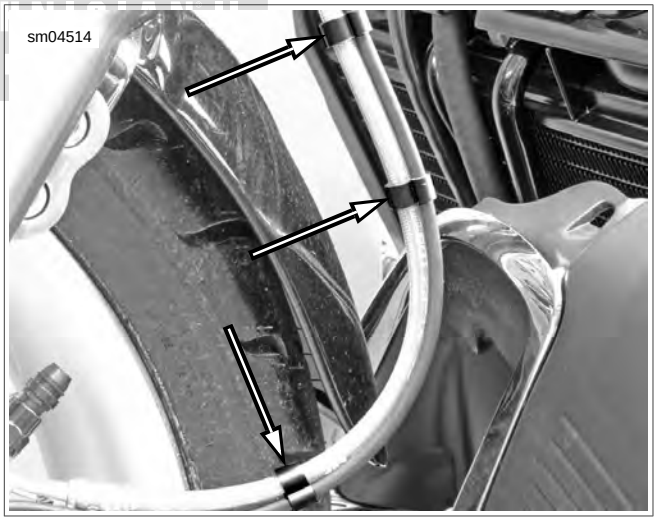
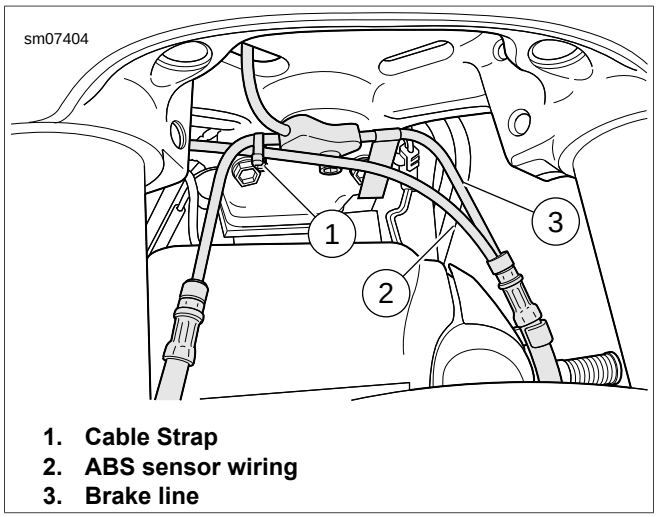


Figure C-7. ABS Sensor Cable to Brake Hose Clips



1. **Cable Strap**
2. **ABS sensor wiring**
3. **Brake line**

Figure C-8. ABS Sensor Routing

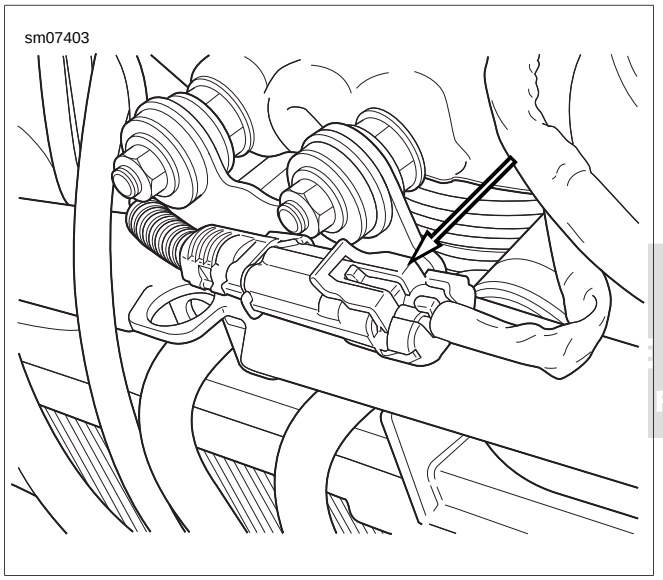


Figure C-9. Front ABS Connector Location

REAR WHEEL SPEED SENSOR

Removal

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse.

NOTE

Note routing of all cable straps and clips before removal. Install cable straps and clips in exact locations as removed.

2. Remove rear axle nut and slide axle out far enough for wheel speed sensor to be removed. See 2.26 REAR WHEEL.
3. Locate hose clips and disconnect sensor cable from brake hose. See routing and locations under C.4 ABS BRAKE LINES.
4. See Figure C-10. Disconnect ABS connector and remove wheel speed sensor from motorcycle.

Installation

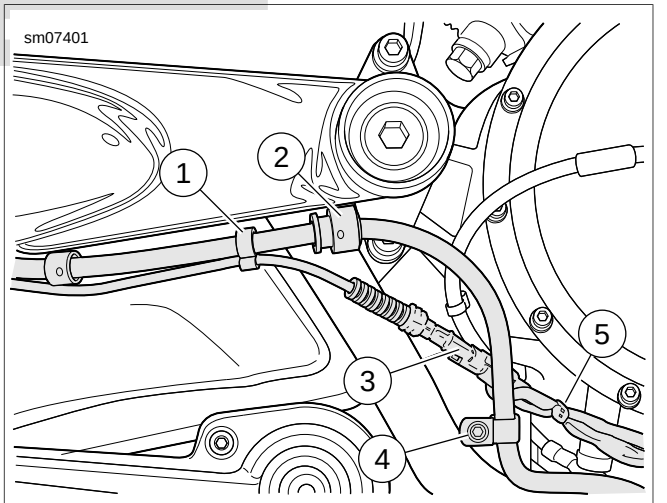
NOTES

- *Never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

1. See Figure C-11. Install wheel speed sensor, slide axle into place and pivot wheel speed sensor upward until locator stops sensor from moving further.
2. Tighten axle and verify belt tension. See 2.26 REAR WHEEL.
3. See Figure C-10. Mate ABS wheel speed sensor connector.
4. Install ABS cable clips and clamps. See C.4 ABS BRAKE LINES for routing and locations.
5. Install main fuse.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **Clip**
2. **Clamp**
3. **WSS connector**
4. **Clamp**
5. **Cable strap**

Figure C-10. Wheel Speed Sensor (WSS) Connector



Figure C-11. ABS Sensor Locator

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

ABS BRAKE LINES C.4

FRONT MASTER CYLINDER TO ABS MODULE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs
Banjo bolt to master cylinder	17-20 Nm	12.5-14.7 ft-lbs
ABS module fasteners	4-6 Nm	35-53 **in-lbs**

Removal

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove side covers.
2. Remove main fuse. See 7.6 MAIN FUSE.
3. Remove air cleaner assembly. See 1.7 AIR CLEANER AND EXHAUST SYSTEM.
4. Disconnect and remove battery. See 1.24 BATTERY MAINTENANCE.
5. Remove starter solenoid from clip on plastic battery tray and remove plastic battery tray from motorcycle.

NOTE

Cover any remaining painted areas to protect them from contact with brake fluid during the removal and installation procedures.

6. Drain front brake system.

NOTE

Note location and routing of brake line prior to removal.

7. See Figure C-12. Remove banjo bolt to release brake line from MF port of ABS module. Discard washers.
8. Loosen ABS module fasteners to allow brake line clearance during disassembly.
9. Remove banjo bolt (2) to release brake line from master cylinder. Discard washers (3).
10. Remove brake line (4) from motorcycle, using caution to avoid spilling any residual brake fluid on finished surfaces.

Installation

1. Route **new** brake line as original brake line was routed.
2. Install lower end of brake line to ABS module with banjo bolt and **new** washer.
3. Tighten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs).
4. Install upper end of brake line to front master cylinder with banjo bolt and **new** washers.
5. Tighten banjo bolt to master cylinder to 17-20 Nm (12.5-14.7 ft-lbs).
6. Tighten ABS module fasteners to 4-6 Nm (35-53 **in-lbs**).
7. Install battery tray components. Install and connect battery.
8. Install main fuse.
9. Install side covers.

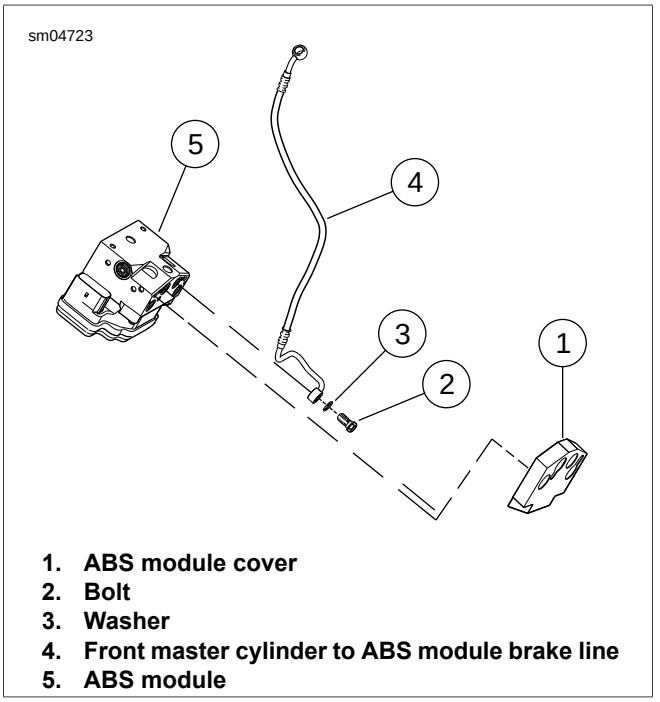
WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

10. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool. Add brake fluid and bleed front brake system.
11. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that front brake system is both properly connected and bled.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **ABS module cover**
2. **Bolt**
3. **Washer**
4. **Front master cylinder to ABS module brake line**
5. **ABS module**

Figure C-12. Front Master Cylinder to ABS Module Brake Line

ABS MODULE TO FRONT BRAKE CALIPERS

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Bleeder screws	23.0-26.0 Nm	17.0-19.2 ft-lbs
Screw	6-10 Nm	53.0-88.4 **in-lbs**
Banjo bolt to ABS module	17.0-20.0 Nm	13.0-14.7 ft-lbs

Removal

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove left side cover.

NOTE

Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.

3. Drain front brake system.

NOTE

Note position and routing of brake lines, clips and cable straps prior to removal.

4. Remove clips (6) from brake hose/ABS sensor cables.
5. Remove cable straps.
6. See Figure C-13. Remove banjo bolt (4) to release brake line from F port of ABS module. Discard washers (3).
7. Remove complete bleeder screw assemblies (8) to release brake lines from front calipers. Discard washers (3).
8. Remove screw (7) and remove brake line assembly from motorcycle.

Installation

1. Route **new** brake line as original brake line was routed.
2. Install lower end of brake line (5) to calipers using bleeder screw assemblies (8) and **new** washers (3).
3. Tighten bleeder screw assemblies to 23.0-26.0 Nm (17.0-19.2 ft-lbs).
4. Install cable straps removed during disassembly.
5. Install screw (7) and tighten to 6-10 Nm (53.0-88.4 **in-lbs**).
6. Tighten banjo bolt to ABS module to 17.0-20.0 Nm (13.0-14.7 ft-lbs).
7. Install main fuse and right side cover. See 7.6 MAIN FUSE.

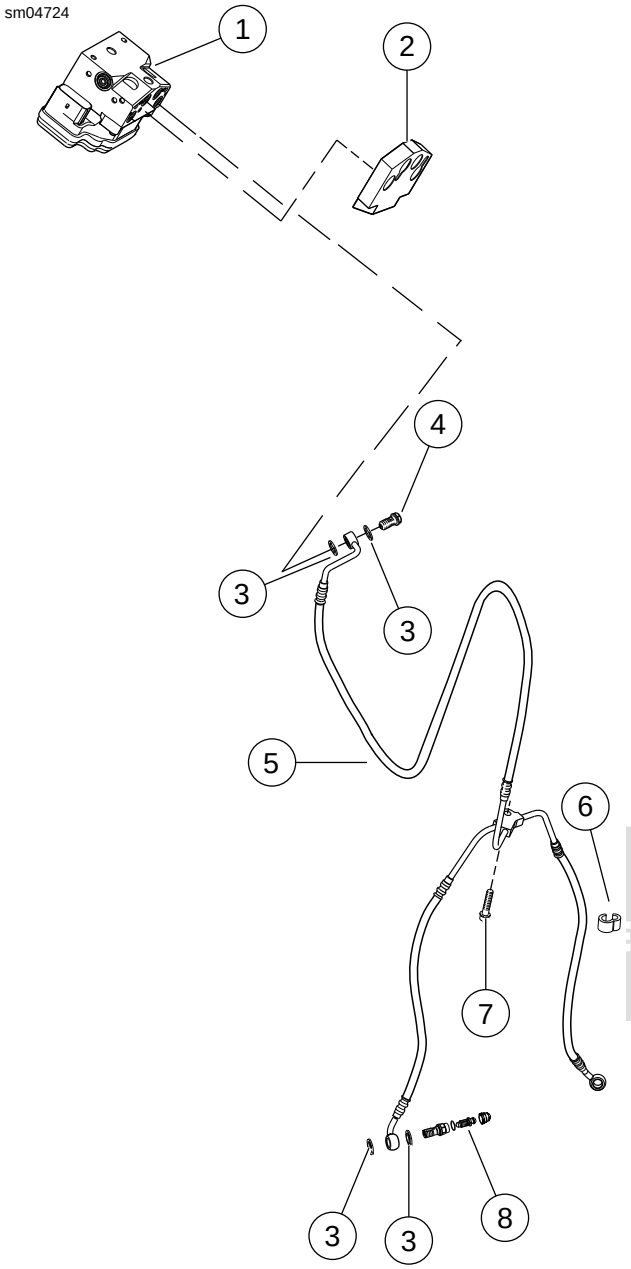
WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

8. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. SNAP-ON BB200A) or equivalent tool. Add brake fluid and bleed front brake system.
9. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that front brake system is both properly connected and bled.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **ABS module**
2. **ABS module cover**
3. **Sealing washer**
4. **Bolt**
5. **ABS module to front calipers brake line**
6. **Clip**
7. **Screw**
8. **Bleeder screw assembly**

Figure C-13. ABS Module to Front Brake Calipers Brake Line

REAR MASTER CYLINDER TO ABS MODULE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A OR EQUIVALENT	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Banjo bolt to master cylinder	23-29 Nm	17-21.4 ft-lbs
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs

Removal

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.

NOTE

Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.

2. Drain rear brake system.

NOTE

Note location and routing of brake line prior to removal.

3. See Figure C-14. Remove banjo bolt to remove brake line from MR port of ABS module. Discard washers.
4. Disconnect wiring lead from stop lamp switch (4).
5. Remove cover and empty master cylinder reservoir.
6. Remove banjo bolt to release brake line from master cylinder. Discard washers.
7. Remove any cable straps (7) retaining brake line and remove brake line from motorcycle.

Installation

1. See Figure C-14. Install **new** brake line exactly as original brake line was routed.
2. Start banjo bolt (5) with **new** washers (3) to secure brake line to MR port of ABS module.

NOTE

*If installing a **new** stop lamp switch, apply LOCTITE 565 THREAD SEALANT to threads and install switch into rear brake line. Tighten switch to 16.3-20.3 Nm (12-15 ft-lbs).*

3. Start banjo bolt (5) with **new** washers (3) to secure brake line to rear master cylinder.
4. Tighten banjo bolt to master cylinder to 23-29 Nm (17-21.4 ft-lbs).
5. Tighten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs).
6. Install wiring harness connector on brake lamp switch.

7. Install cable straps previously removed.
8. Verify clearance between brake line and exhaust system.
9. Fill and bleed brake system. See 2.21 BLEEDING BRAKES.

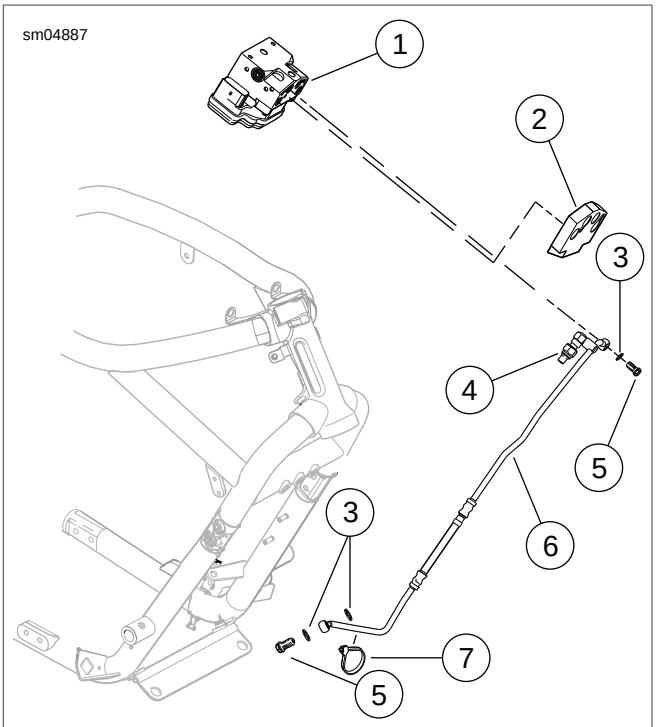
WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

10. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A or equivalent). Add brake fluid and bleed front brake system.
11. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that rear brake system is both properly connected and bled.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **ABS module**
2. **ABS module cover**
3. **Sealing washer**
4. **Stop lamp switch**
5. **Bolt**
6. **ABS module to rear master cylinder brake line**
7. **Cable strap**

Figure C-14. ABS Module To Rear Master Cylinder

ABS MODULE TO REAR BRAKE CALIPER

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II
SNAP-ON BB200A OR EQUIVALENT	BASIC VACUUM BRAKE BLEEDER

FASTENER	TORQUE VALUE	
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**
Brake line clamp fastener (to frame)	6-10 Nm	53.1-88.4 **in-lbs**
Banjo bolt to calipers	23-29 Nm	17-21.4 ft-lbs
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs

Removal

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See 7.6 MAIN FUSE.
2. Remove right side radiator cover. See 1.16 RADIATOR SIDE COVERS.

NOTE

Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.

3. Drain rear brake system.
4. Remove cover and empty master cylinder reservoir.
5. Remove exhaust system. See 4.15 EXHAUST SYSTEM: VRSCF or 4.14 EXHAUST SYSTEM: VRSCDX.

NOTE

Note location and routing of brake line prior to removal.

6. See Figure C-15. Remove banjo bolt to remove brake line from R port of ABS module. Discard sealing washers.
7. Remove banjo bolt to release brake line from rear caliper. Discard sealing washers.
8. Remove any cable straps, clips and clamps retaining brake line.
9. Remove brake line from motorcycle.

Installation

1. Install **new** brake line exactly as original brake line was routed.
2. See Figure C-15. Start banjo bolt (5) with **new** sealing washers (3) to secure brake line to R port (2) of ABS module (4).
3. See Figure C-16. Start banjo bolt (3) with **new** sealing washers (2) to secure brake line (1) to rear brake caliper.
4. See Figure C-17. Route brake line (4) and wiring (5). Attach to rear fork as shown. Clamps (1) face away from vehicle and clamps (3) face towards vehicle.
5. Tighten clamp fasteners to 5-7 Nm (44.2-61.9 **in-lbs**).
6. Attach clips (2) as shown.
7. See Figure C-18. Install clamp (2). Tighten clamp fastener to 5-7 Nm (44.2-61.9 **in-lbs**).
8. Attach clip (1).
9. Install brake line in clamp (4). Tighten clamp fastener to 6-10 Nm (53.1-88.4 **in-lbs**).
10. Wrap the cable strap (5) around the brake line, WSS wiring and clutch line.

NOTE

See Figure C-19. Wire retainers (3, 5) must rest against T-studs (1, 6) on frame. Verify that wire retainers do not contact exhaust system.

11. Secure brake line, clutch line (4) and wire harness (2) to frame with wire retainers.

NOTE

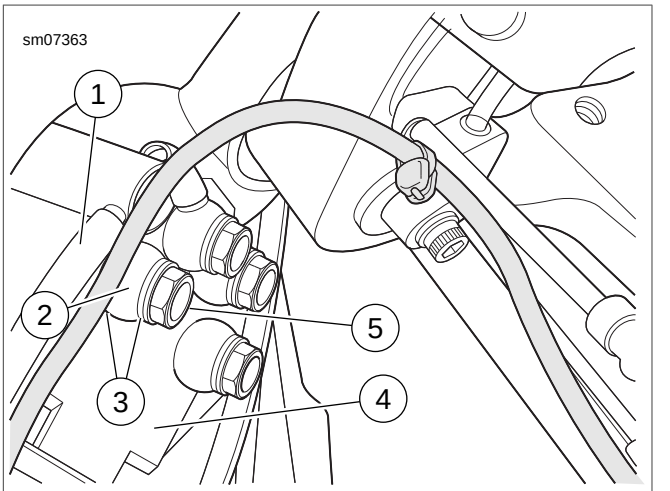
See Figure C-20. Rear brake line from HCU to rear caliper not shown. Brake line is routed behind clutch line.

12. Wrap cable strap (3) around the brake line (2), wire harness (4) and clutch line (1).

NOTE

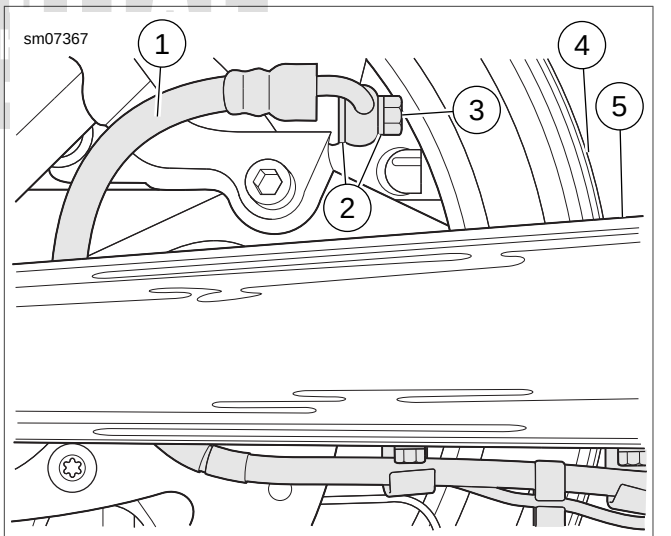
See Figure C-21. Rear brake line not shown. Brake line is routed behind clutch line.

13. Wrap cable strap (3) around the oil line (1), wire harness (2), clutch line (4) and brake line (not pictured).



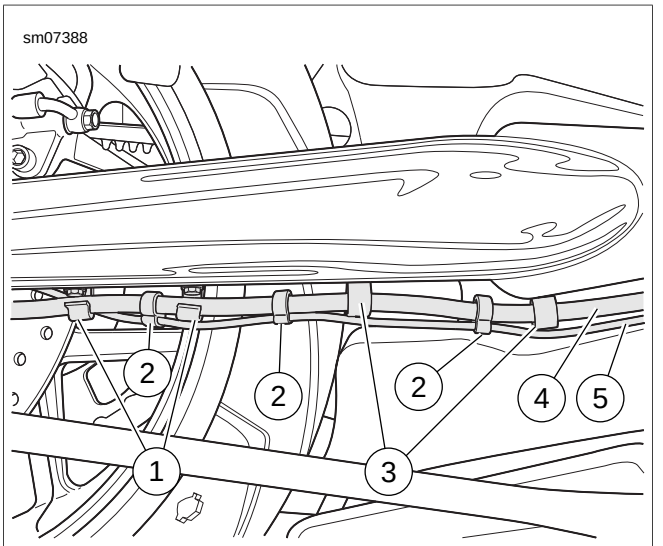
1. **ABS module to rear brake caliper brake line**
2. **R port location**
3. **Sealing washers**
4. **ABS module**
5. **Banjo bolt**

Figure C-15. ABS Module R Port Location



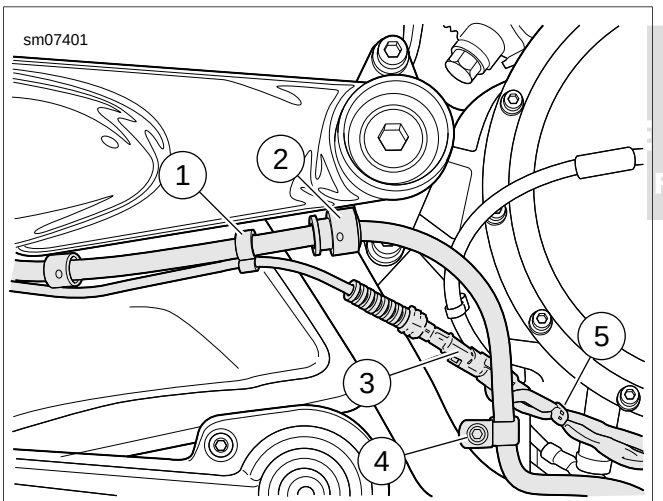
1. **Rear brake caliper brake line**
2. **Sealing washers**
3. **Banjo bolt**
4. **Rear tire**
5. **Rear fork**

Figure C-16. Rear Brake Caliper Brake Line



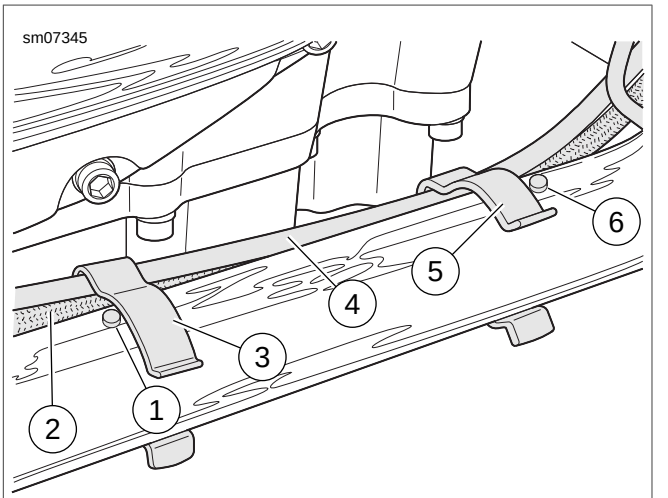
1. Clamp (outward facing)
2. Clip
3. Clamp (inward facing)
4. Brake line
5. Wiring

Figure C-17. Brake Line (Rear Fork)



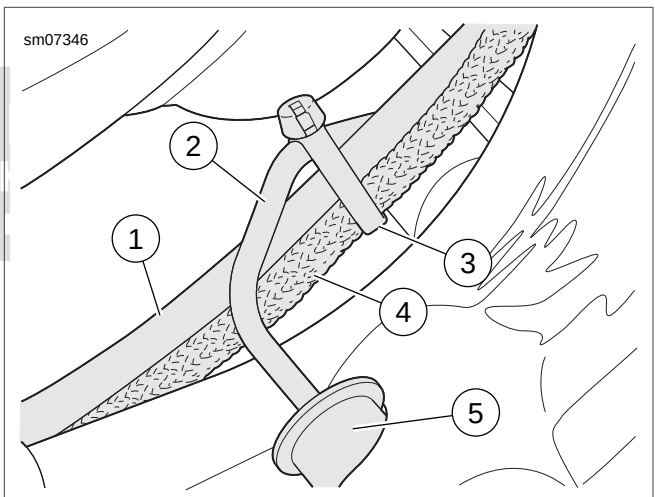
1. Clip
2. Clamp
3. WSS connector
4. Clamp
5. Cable strap

Figure C-18. Wheel Speed Sensor (WSS) Connector



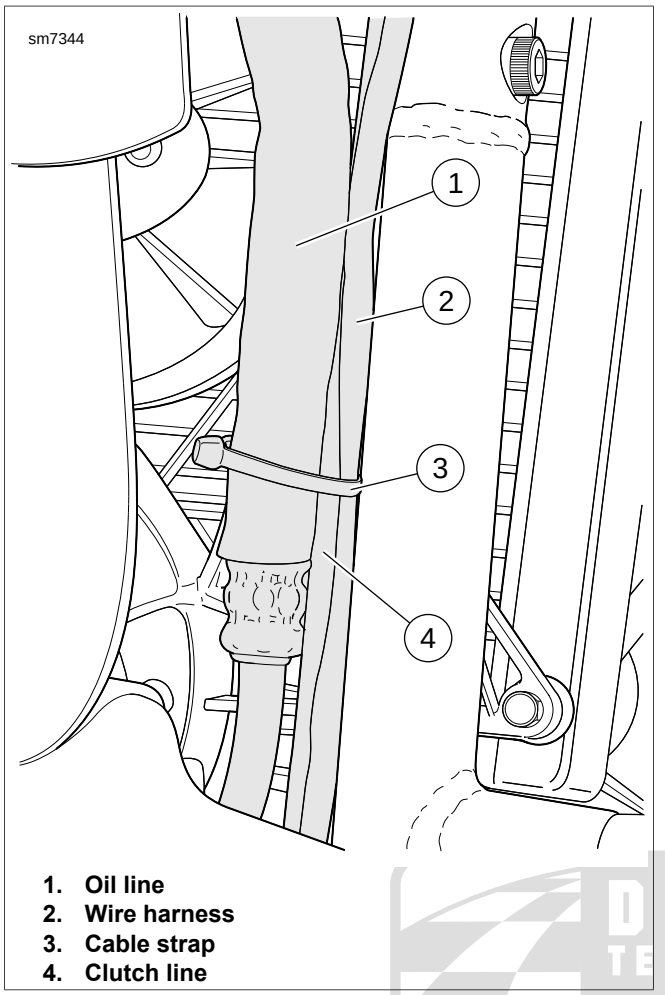
1. T-stud
2. Wire harness
3. Wire retainer
4. Clutch line
5. Wire retainer
6. T-stud

Figure C-19. Wire Retainers



1. Clutch line
2. Rear brake line to HCU
3. Cable strap
4. Wire harness
5. To rear brake master cylinder

Figure C-20. Clutch Line Routing (Right Footrest Area)



1. **Oil line**
2. **Wire harness**
3. **Cable strap**
4. **Clutch line**

Figure C-21. Right Downtube Routing

14. Tighten banjo bolt to caliper to 23-29 Nm (17-21.4 ft-lbs).
15. Tighten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs).
16. Install right side radiator cover. See 1.16 RADIATOR SIDE COVERS.
17. Install exhaust system. See 4.15 EXHAUST SYSTEM: VRSCF or 4.14 EXHAUST SYSTEM: VRSCDX.
18. Install main fuse. See 7.6 MAIN FUSE.

⚠WARNING

Any time the ABS module, either master cylinder, or any line between a master cylinder and the ABS module is disconnected or replaced, Digital Technician II must be used during the brake bleeding procedure to verify all air is removed from the system. Failure to do so could result in air in the hydraulic brake system, reducing brake efficiency, which could result in death or serious injury. (00585b)

19. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A or equivalent). Add brake fluid and bleed front brake system.
20. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that rear brake system is both properly connected and bled.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

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DIGITAL TECHNICIAN® II
HARLEY-DAVIDSON®

NOTES

VALVE TAPPET SHIMS D.1

TABLES

Table D-1. Case 1 Valve Tappet Shims

PART NO.	SHIM THICKNESS
H-D 18696-01K	1.825 mm
H-D 18697-01K	1.850 mm
H-D 18697-01K	1.850 mm
H-D 18698-01K	1.875 mm
H-D 18699-01K	1.900 mm
H-D 18700-01K	1.925 mm
H-D 18701-01K	1.950 mm
H-D 18702-01K	1.975 mm
H-D 18666-01K	2.000 mm
H-D 18624-01K	2.025 mm
H-D 18667-01K	2.050 mm
H-D 18625-01K	2.075 mm
H-D 18668-01K	2.100 mm
H-D 18626-01K	2.125 mm
H-D 18669-01K	2.150 mm
H-D 18627-01K	2.175 mm
H-D 18670-01K	2.200 mm
H-D 18628-01K	2.225 mm
H-D 18628-01K	2.250 mm
H-D 18629-01K	2.275 mm
H-D 18672-01K	2.300 mm
H-D 18630-01K	2.325 mm
H-D 18673-01K	2.350 mm
H-D 18631-01K	2.375 mm
H-D 18674-01K	2.400 mm

Table D-2. Case 2 Valve Tappet Shims

PART NO.	SHIM THICKNESS
H-D 18632-01K	2.425 mm
H-D 18675-01K	2.450 mm
H-D 18638-01K	2.475 mm
H-D 18676-01K	2.500 mm
H-D 18639-01K	2.525 mm
H-D 18677-01K	2.550 mm
H-D 18655-01K	2.575 mm
H-D 18678-01K	2.600 mm
H-D 18656-01K	2.625 mm
H-D 18679-01K	2.650 mm
H-D 18657-01K	2.675 mm
H-D 18680-01K	2.700 mm
H-D 18658-01K	2.725 mm
H-D 18681-01K	2.750 mm
H-D 18659-01K	2.775 mm
H-D 18682-01K	2.800 mm
H-D 18692-01K	2.825 mm
H-D 18683-01K	2.850 mm
H-D 18693-01K	2.875 mm
H-D 18684-01K	2.900 mm
H-D 18694-01K	2.925 mm
H-D 18685-01K	2.950 mm
H-D 18695-01K	2.975 mm
H-D 18686-01K	3.000 mm

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VALVE LASH CALCULATION WORKSHEET 1 D.2

WORKSHEET 1

Table D-3. Valve Lash: Front Cylinder (Measurements)

VALVE NUMBER	VALVE TYPE	INITIAL LASH MEASUREMENT (1)	INSTALLED SHIM MEASUREMENT (2)	VALVE LASH UPPER LIMIT, MM (IN.) (3)	VALVE LASH LOWER LIMIT, MM (IN.) (4)
1	Exhaust			0.345 (0.0135)	0.295 (0.0117)
2	Exhaust			0.345 (0.0135)	0.295 (0.0117)
3	Intake			0.245 (0.0096)	0.195 (0.0078)
4	Intake			0.245 (0.0096)	0.195 (0.0078)

Table D-4. Valve Lash: Front Cylinder (Calculations)

VALVE NUMBER	VALVE TYPE	NEW SHIM LOWER LIMIT CALCULATE COLUMNS (1)+(2)-(3) (L)	NEW SHIM UPPER LIMIT CALCULATE COLUMNS (1)+(2)-(4) (U)	DESIRED SHIM SIZE CALCULATE COLUMNS ((L)+(U))/(2) = (S) (S)	SHIM SIZE CHOSEN (CLOSEST TO COLUMN S)	FINAL LASH READING
1	Exhaust					
2	Exhaust					
3	Intake					
4	Intake					

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Table D-5. Valve Lash: Rear Cylinder (Measurements)

VALVE NUMBER	VALVE TYPE	INITIAL LASH MEASUREMENT (1)	INSTALLED SHIM MEASUREMENT (2)	VALVE LASH UPPER LIMIT, MM (IN.) (3)	VALVE LASH LOWER LIMIT, MM (IN.) (4)
5	Intake			0.245 (0.0096)	0.195 (0.0078)
6	Intake			0.245 (0.0096)	0.195 (0.0078)
7	Exhaust			0.345 (0.0135)	0.295 (0.0117)
8	Exhaust			0.345 (0.0135)	0.295 (0.0117)

Table D-6. Valve Lash: Rear Cylinder (Calculations)

VALVE NUMBER	VALVE TYPE	NEW SHIM LOWER LIMIT CALCULATE COLUMNS (1)+(2)-(3) (L)	NEW SHIM UPPER LIMIT CALCULATE COLUMNS (1)+(2)-(4) (U)	DESIRED SHIM SIZE CALCULATE COLUMNS ((L)+(U))/(2) = (S) (S)	SHIM SIZE CHOSEN (CLOSEST TO COLUMN S)	FINAL LASH READING
5	Intake					
6	Intake					
7	Exhaust					
8	Exhaust					

VALVE LASH CALCULATION WORKSHEET 2 D.3

WORKSHEET 2

Table D-7. Valve Lash: Front Cylinder (Measurements)

VALVE NUMBER	VALVE TYPE	INITIAL LASH MEASUREMENT (1)	INSTALLED SHIM MEASUREMENT (2)	VALVE LASH UPPER LIMIT, MM (IN.) (3)	VALVE LASH LOWER LIMIT, MM (IN.) (4)
1	Exhaust			0.345 (0.0135)	0.295 (0.0117)
2	Exhaust			0.345 (0.0135)	0.295 (0.0117)
3	Intake			0.245 (0.0096)	0.195 (0.0078)
4	Intake			0.245 (0.0096)	0.195 (0.0078)

Table D-8. Valve Lash: Front Cylinder (Calculations)

VALVE NUMBER	VALVE TYPE	NEW SHIM LOWER LIMIT CALCULATE COLUMNS (1)+(2)-(3) (L)	NEW SHIM UPPER LIMIT CALCULATE COLUMNS (1)+(2)-(4) (U)	DESIRED SHIM SIZE CALCULATE COLUMNS ((L)+(U))/(2) = (S) (S)	SHIM SIZE CHOSEN (CLOSEST TO COLUMN S)	FINAL LASH READING
1	Exhaust					
2	Exhaust					
3	Intake					
4	Intake					

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Table D-9. Valve Lash: Rear Cylinder (Measurements)

VALVE NUMBER	VALVE TYPE	INITIAL LASH MEASUREMENT (1)	INSTALLED SHIM MEASUREMENT (2)	VALVE LASH UPPER LIMIT, MM (IN.) (3)	VALVE LASH LOWER LIMIT, MM (IN.) (4)
5	Intake			0.245 (0.0096)	0.195 (0.0078)
6	Intake			0.245 (0.0096)	0.195 (0.0078)
7	Exhaust			0.345 (0.0135)	0.295 (0.0117)
8	Exhaust			0.345 (0.0135)	0.295 (0.0117)

Table D-10. Valve Lash: Rear Cylinder (Calculations)

VALVE NUMBER	VALVE TYPE	NEW SHIM LOWER LIMIT CALCULATE COLUMNS (1)+(2)-(3) (L)	NEW SHIM UPPER LIMIT CALCULATE COLUMNS (1)+(2)-(4) (U)	DESIRED SHIM SIZE CALCULATE COLUMNS ((L)+(U))/(2) = (S) (S)	SHIM SIZE CHOSEN (CLOSEST TO COLUMN S)	FINAL LASH READING
5	Intake					
6	Intake					
7	Exhaust					
8	Exhaust					

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LENGTH CONVERSION E.1

CONVERSION TABLE

Table E-1. Metric Conversions

MILLIMETERS to INCHES (MM x 0.03937 = IN)								INCHES to MILLIMETERS (IN x 25.40 = MM)							
mm	in	mm	in	mm	in	mm	in	in	mm	in	mm	in	mm	in	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1-15/16	49.21	3-5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3-3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2-1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3-7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2-1/8	53.97	3-1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2-3/16	55.56	3-9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2-1/4	57.15	3-5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3-11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2-5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2-3/8	60.32	3-3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1-1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2-7/16	61.91	3-13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1-1/8	28.57	2-1/2	63.50	3-7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1-3/16	30.16	2-9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3-15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1-1/4	31.75	2-5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2-11/16	68.26	4-1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1-5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1-3/8	34.92	2-3/4	69.85	4-1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4-3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1-7/16	36.51	2-13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1-1/2	38.10	2-7/8	73.02	4-1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1-9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2-15/16	74.61	4-5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1-5/8	41.27	3	76.20	4-3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1-11/16	42.86	3-1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4-7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1-3/4	44.45	3-1/8	79.37	4-1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3-3/16	80.96	4-9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1-13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1-7/8	47.62	3-1/4	82.55	4-5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4-11/16	119.06

FLUID CONVERSION E.2

UNITED STATES SYSTEM

Unless otherwise specified, all fluid volume measurements in this service manual are expressed in United States (U.S.) units-of-measure. See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this service manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert between U.S. units-of-measure and metric units-of-measure, refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this service manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert between U.S. units and British Imperial units, refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

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TORQUE CONVERSION E.3

UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) X 12.00000 = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) X 0.08333 = foot pounds (ft-lbs).

METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) X 0.737563 = foot pounds (ft-lbs).
- Newton meters (Nm) X 8.85085 = inch pounds (**in-lbs).**
- foot pounds (ft-lbs) X 1.35582 = Newton meters (Nm).
- inch pounds (**in-lbs**) X 0.112985 = Newton meters (Nm).

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GLOSSARY F.1

ACRONYMS AND ABBREVIATIONS

Table F-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
ABS	Anti-lock braking system
Ah	Ampere-hour
AC	Alternating current
ACC	Accessory position on ignition switch
ACR	Automatic compression release
AIS	Active Intake Solenoid
AGM	Absorbed glass mat (battery)
AWG	American wire gauge
B+	Battery voltage
bar	Bar
BAS	Bank angle sensor
BCM	Body control module
BOB	Breakout box
BTDC	Before top dead center
°C	Celsius (Centigrade)
CA	California
CAL	Calibration
CAN	Controller area network
cc	Cubic centimeters
cm	Centimeters
cm^3	Cubic centimeters
CCA	Cold cranking amps
CKP	Crankshaft position
cm	Centimeter
CCW	Counterclockwise
CW	Clockwise
DC	Direct current
DLC	Data link connector
DOM	Domestic
DTC	Diagnostic trouble code
DOT	Department of Transportation
DVOM	Digital volt ohm meter
ECM	Electronic control module
ECT	Engine coolant temperature
ECU	Electronic Control Unit
EEPROM	Electrically erasable programmable read only memory
EFI	Electronic fuel injection
EHCU	Electro Hydraulic Control Unit
ET	Engine temperature

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Table F-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
EVAP	Evaporative emissions control system
°F	Fahrenheit
FPS	Fuel pressure sensor
ft	Foot
ft-lbs	Foot pounds
fl oz	Fluid ounce
g	Gram
gal	Gallon
GAWR	Gross axle weight rating
GPS	Global positioning system
GND	Ground (electrical)
GVWR	Gross vehicle weight rating
HCU	Hydraulic control unit
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson smart security system
HFSM	Hands-free security module
Hg	Mercury
H02S	Heated oxygen sensor
hp	Horsepower
hr	Hour
IAC	Idle air control
IAT	Intake air temperature
IC	Instrument cluster
ID	Inside diameter
IGN	Ignition light/key switch position
in	Inch
in^3	Cubic inch
INJ PW	Injector pulse width
in-lbs	Inch pounds
JSS	Jiffy stand sensor
kg	Kilogram
km	Kilometer
kPa	Kilopascal
km/h	Kilometers per hour
kW	Kilowatt
L	Liter
lb	Pounds
LCD	Liquid crystal display
LED	Light emitting diode
LHCM	Left hand control module
LP	License plate
mA	Milliampere
MAP	Manifold absolute pressure

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Table F-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
max	Maximum
mi	Mile
min	Minimum
mL	Milliliter
mm	Millimeter
mph	Miles per hour
ms	Millisecond
Nm	Newton-meter
NIM	Navigation interface module
NiMH	Nickel metal hydride
N/A	Not applicable
O2	Oxygen
OD	Outside diameter
OEM	Original equipment manufacturer
oz	Ounce
P&A	Parts and Accessories
Part No.	Part number
PIN	Personal identification number
psi	Pounds per square inch
PWM signal	Pulse width modulated signal
qt	Quart
RCM	Reverse control module
RES	Reserve mark on fuel supply valve
RHCM	Right hand control module
rpm	Revolutions per minute
s	Seconds
SCFH	Cubic feet per hour at standard conditions
SPDO	Speedometer
SPKR	Speaker
STT	Stop/tail/turn
TCA	Throttle control actuator
TDC	Top dead center
TGS	Twist grip sensor
TMAP	Intake air temperature/manifold absolute pressure
TPS	Throttle position sensor
TSM	Turn signal module
TSSM	Turn signal/security module
V	Volt
VAC	Volts of alternating current
VDC	Volts of direct current
VIN	Vehicle identification number
VSS	Vehicle speed sensor

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Table F-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
W	Watt
WSS	Wheel speed sensor

DIGITAL TECHNICIAN II HARLEY-DAVIDSON

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
1MFLE140 SNAP-ON	SOCKET	3.10 CYLINDER HEAD, Removal
99863-01A	GLOBAL BATTERY CHARGER	1.24 BATTERY MAINTENANCE, Storage
B-42571	FORK SEAL DRIVER	2.32 FRONT FORK, Assembly
B-42571	FORK SEAL DRIVER	2.32 FRONT FORK, Assembly
B-50085	TERMINAL EXTRACTOR	A.16 JAE MX19 SEALED CONNECTORS, JAE MX19 Sealed Connectors
GA500A	SNAP-ON TERMINAL PICK	A.1 AUTOFUSE UNSEALED ELECTRICAL CONNECTORS, Autofuse Unsealed Connector Repair
HD-23688	COOLANT TESTER (FAHRENHEIT)	5.4 ENGINE COOLANT, Drain and Fill Cooling System
HD-25070	ROBINAIR HEAT GUN	5.7 COOLANT PIPES AND HOSES, Assembly
HD-25070	ROBINAIR HEAT GUN	7.28 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-25070	HEAT GUN	A.20 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-26568	COOLANT TESTER (CELSIUS)	5.4 ENGINE COOLANT, Drain and Fill Cooling System
HD-29545-6	COOLANT FLUORESCENT LEAK DETECTION DYE	5.3 COOLANT FLOW, Leak Detection Dye Test
HD-33223-1	CYLINDER COMPRESSION GAUGE	3.7 TROUBLESHOOTING, Compression Test
HD-33416	UNIVERSAL DRIVER HANDLE	2.33 STEERING HEAD, Cleaning and Inspection
HD-34736-B	VALVE SPRING COMPRESSOR	3.10 CYLINDER HEAD, Disassembly
HD-34736-B	VALVE SPRING COMPRESSOR	3.10 CYLINDER HEAD, Head Assembly
HD-34751	VALVE GUIDE CLEANING BRUSH	3.10 CYLINDER HEAD, Disassembly
HD-34751	VALVE GUIDE CLEANING BRUSH	3.10 CYLINDER HEAD, Valve Seat Refacing
HD-34902-B	BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER	6.5 COUNTERBALANCER BEARING REPLACEMENT, Removal
HD-34902-B	BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER	6.8 INPUT SHAFT, Disassembly: 2nd Gear End
HD-35381	BELT TENSION GAUGE	1.10 DRIVE BELT AND SPROCKETS, Checking and Adjusting Drive Belt Deflection
HD-35457	BLACK LIGHT LEAK DETECTOR	5.3 COOLANT FLOW, Leak Detection Dye Test
HD-35667A	CYLINDER LEAKDOWN TESTER	3.7 TROUBLESHOOTING, Cylinder Leakage Test
HD-35758-50	NEWAY VALVE SEAT CUTTER SET	3.10 CYLINDER HEAD, Valve Seat Refacing
HD-35758-51	6 MM PILOT	3.10 CYLINDER HEAD, Disassembly
HD-38125-6	PACKARD TERMINAL CRIMP TOOL	A.8 DELPHI METRI-PACK TERMINAL REPAIR, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.8 DELPHI METRI-PACK TERMINAL REPAIR, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.14 DEUTSCH DTM SEALED MINI TERMINAL REPAIR, Deutsch DTM Sealed Mini Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.8 DELPHI METRI-PACK TERMINAL REPAIR, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.20 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39301-A	STEERING HEAD BEARING RACE REMOVER	2.33 STEERING HEAD, Cleaning and Inspection
HD-39302	STEERING HEAD BEARING RACE INSTALLER	2.33 STEERING HEAD, Assembly
HD-39782	CYLINDER HEAD SUPPORT STAND	3.10 CYLINDER HEAD, Disassembly

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-39782-13	CYLINDER SUPPORT ADAPTER	3.10 CYLINDER HEAD, Disassembly
HD-39782-14	CYLINDER SUPPORT ADAPTER	3.10 CYLINDER HEAD, Disassembly
HD-39786	CYLINDER HEAD HOLDING FIXTURE	3.10 CYLINDER HEAD, Removal
HD-39786	CYLINDER HEAD HOLDING FIXTURE	3.10 CYLINDER HEAD, Valve Seat Refacing
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.13 DEUTSCH DT SEALED TERMINAL REPAIR, Deutsch DT Sealed Terminal Crimps
HD-39969	ULTRA TORCH UT-100	7.28 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-39969	ULTRA TORCH	A.20 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41137	HOSE CLAMP PLIERS	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Disassembly
HD-41177	FORK TUBE HOLDER	2.32 FRONT FORK, Disassembly
HD-41177	FORK TUBE HOLDER	2.32 FRONT FORK, Disassembly
HD-41177	FORK TUBE HOLDER	2.32 FRONT FORK, Disassembly
HD-41177	FORK TUBE HOLDER	2.32 FRONT FORK, Assembly
HD-41177	FORK TUBE HOLDER	2.32 FRONT FORK, Assembly
HD-41182	FUEL PRESSURE GAUGE	4.13 FUEL PRESSURE TEST, Testing
HD-41183	HEAT SHIELD ATTACHMENT	7.28 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-41183	HEAT SHIELD ATTACHMENT	A.20 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41417	PROPANE ENRICHMENT KIT	4.16 INTAKE LEAK TEST, Leak Tester
HD-41475	DEUTSCH TERMINAL REPAIR KIT	A.12 DEUTSCH DT SEALED CONNECTORS, Deutsch DT Sealed Connector Repair
HD-41475-100	FLAT BLADE L-HOOK	A.12 DEUTSCH DT SEALED CONNECTORS, Deutsch DT Sealed Connector Repair
HD-41609	AMP MULTI-LOCK CRIMPER	A.19 TYCO 070 MULTILOCK UNSEALED CONNECTOR, Tyco 070 Multilock Unsealed Connector Repair
HD-41609	AMP MULTI-LOCK CRIMPER	A.19 TYCO 070 MULTILOCK UNSEALED CONNECTOR, Tyco 070 Multilock Unsealed Connector Repair
HD-42310	ENGINE TRANSMISSION STAND	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand
HD-42310-100	CRADLE LOCKING NUT AND SPACER	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand
HD-42310-100	CRADLE LOCKING NUT AND SPACER RING	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand
HD-42310-40	ENGINE CRADLE	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand
HD-42879	ELECTRICAL CRIMPER TOOL	A.15 DEUTSCH DTM SEALED SOLID BARREL MINI TERMINAL REPAIR, Deutsch DTM Sealed Solid Barrel Terminal Crimps
HD-43526	PRIMARY CHAIN TENSIONER RETAINER	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Removal
HD-43646-A	ROLLING ENGINE STAND	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand

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Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-43646-A	ROLLING ENGINE STAND	3.8 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand
HD-44060-4	WHEEL BEARING REMOVAL/REPLACEMENT KIT	2.37 REAR FORK, Disassembly and Assembly
HD-44060C	WHEEL BEARING INSTALLER/REMOVER	2.27 SEALED WHEEL BEARINGS, Removal
HD-44067	OIL FILTER WRENCH	1.6 ENGINE OIL AND FILTER, Changing Oil and Filter
HD-44358	FLYWHEEL SUPPORT FIXTURE	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-45300	OIL PRESSURE SWITCH SOCKET	7.24 OIL PRESSURE SWITCH, Removal
HD-45301	TRANSMISSION ASSEMBLY RETAINER TOOL	3.11 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly
HD-45301	TRANSMISSION ASSEMBLY RETAINER TOOL	6.4 TRANSMISSION, Assembly
HD-45301	TRANSMISSION ASSEMBLY RETAINER	6.4 TRANSMISSION, Assembly
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER	3.11 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL	7.19 ALTERNATOR, Removal
HD-45304	ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL	7.19 ALTERNATOR, Installation
HD-45307	THERMOSTAT REMOVAL TOOL	5.5 THERMOSTAT, Removal
HD-45308	OIL PRESSURE GAUGE	3.6 OIL PRESSURE, Checking Oil Pressure
HD-45309	ADAPTER	3.6 OIL PRESSURE, Checking Oil Pressure
HD-45310	LOWER CRANKCASE ALIGNMENT DOWELS	6.4 TRANSMISSION, Assembly
HD-45311	COUNTERBALANCER ALIGNMENT PIN	6.4 TRANSMISSION, Assembly
HD-45311	COUNTERBALANCER ALIGNMENT PIN	6.4 TRANSMISSION, Assembly
HD-45311	COUNTERBALANCER ALIGNMENT PIN	6.5 COUNTERBALANCER BEARING REPLACEMENT, Installation
HD-45312	CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER	3.10 CYLINDER HEAD, Removal
HD-45313	CYLINDER LINER REMOVER/INSTALLER	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-45314	CRANKSHAFT ROTATING WRENCH	1.20 VALVE LASH, Lash Measurement
HD-45314	CRANKSHAFT ROTATING WRENCH	1.20 VALVE LASH, Verify Cam Timing
HD-45314	CRANKSHAFT ROTATING WRENCH	1.21 SECONDARY CAM CHAIN, Adjustment
HD-45314	CRANKSHAFT ROTATING WRENCH	3.7 TROUBLESHOOTING, Cylinder Leakage Test
HD-45314	CRANKSHAFT ROTATING WRENCH	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal
HD-45314	CRANKSHAFT ROTATING WRENCH	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
HD-45314	CRANKSHAFT ROTATING WRENCH	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45314	CRANKSHAFT ROTATING WRENCH	6.3 CLUTCH, Removal
HD-45314	CRANKSHAFT ROTATING WRENCH	7.19 ALTERNATOR, Removal

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-45314	CRANKSHAFT ROTATING WRENCH	7.19 ALTERNATOR, Installation
HD-45315	ALTERNATOR ROTOR REMOVER	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal
HD-45315	ALTERNATOR ROTOR REMOVER	7.19 ALTERNATOR, Removal
HD-45316	CRANKSHAFT ASSEMBLY RETAINER	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45316	CRANKSHAFT ASSEMBLY RETAINER	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-45316	CRANKSHAFT ASSEMBLY RETAINER	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-45316	CRANKSHAFT ASSEMBLY RETAINER	6.4 TRANSMISSION, Assembly
HD-45317	ENGINE ASSEMBLY SUPPORT FIXTURE	2.8 ENGINE REPLACEMENT, Removal
HD-45319	VALVE GUIDE REAMER	3.10 CYLINDER HEAD, Disassembly
HD-45320	VALVE GUIDE REMOVER/INSTALLER	3.10 CYLINDER HEAD, Disassembly
HD-45321	VALVE GUIDE FLEX HONE	3.10 CYLINDER HEAD, Disassembly
HD-45322	VALVE GUIDE SEAL INSTALLER	3.10 CYLINDER HEAD, Head Assembly
HD-45326	PRIMARY CAM CHAIN TENSIONER RETAINER	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL	6.10 DRIVE SPROCKET FLANGE, Replacement
HD-45331-A	FINAL DRIVE SPROCKET FLANGE LOCKING TOOL	6.10 DRIVE SPROCKET FLANGE, Replacement
HD-45332	FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
HD-45332	FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER	6.10 DRIVE SPROCKET FLANGE, Replacement
HD-45333	CYLINDER HEAD HOLDER	3.10 CYLINDER HEAD, Removal
HD-45333	CYLINDER HEAD HOLDER	3.10 CYLINDER HEAD, Valve Seat Refacing
HD-45334	SECONDARY CAM CHAIN MEASUREMENT TOOL	1.21 SECONDARY CAM CHAIN, Adjustment
HD-45334	SECONDARY CAM CHAIN MEASUREMENT TOOL	3.7 TROUBLESHOOTING, Diagnosing Valve Train Noise
HD-45335	COOLANT SYSTEM PRESSURE TESTER	5.3 COOLANT FLOW, Pressure Cap Test
HD-45335	COOLANT SYSTEM PRESSURE TESTER	5.3 COOLANT FLOW, Tests for Blown Gasket
HD-45337	SHIFT SHAFT SEAL INSTALLER	6.6 SHIFT SHAFT AND SEAL, Installation
HD-45338	SHIFT LEVER SUBSTITUTE	6.4 TRANSMISSION, Assembly
HD-45339	SHIFT MECHANISM/DENTENT RETRACTOR	6.4 TRANSMISSION, Disassembly
HD-45340	GASKET ALIGNMENT DOWELS	1.20 VALVE LASH, Lash Adjustment

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Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-45340	GASKET ALIGNMENT DOWELS	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45340	GASKET ALIGNMENT DOWELS	3.11 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly
HD-45340	GASKET ALIGNMENT DOWELS	6.3 CLUTCH, Installation
HD-45340	GASKET ALIGNMENT DOWELS	7.19 ALTERNATOR, Removal
HD-45340	GASKET ALIGNMENT DOWELS	7.19 ALTERNATOR, Installation
HD-45490	BALANCER BEARING REMOVER/INSTALLER TOOLS	6.5 COUNTERBALANCER BEARING REPLACEMENT, Removal
HD-45490	BALANCER BEARING REMOVER/INSTALLER TOOLS	6.5 COUNTERBALANCER BEARING REPLACEMENT, Installation
HD-45491	TAPPET COMPRESSING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal
HD-45491	TAPPET COMPRESSING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45491	TAPPET COMPRESSING TOOL	3.10 CYLINDER HEAD, Removal
HD-45653	TDC POSITIONING TOOL	1.20 VALVE LASH, Verify Cam Timing
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft and Secondary Timing Chain Removal
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45653	TDC POSITIONING TOOL	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
HD-45654	CLUTCH DISC ALIGNING SPACER	6.3 CLUTCH, Assembly
HD-45928	TERMINAL REMOVER	A.9 DELPHI MICRO 64 SEALED CONNECTORS, Delphi Micro 64 Sealed Connector Repair
HD-45929	TERMINAL CRIMPER	A.9 DELPHI MICRO 64 SEALED CONNECTORS, Delphi Micro 64 Sealed Connector Repair
HD-45966	FRONT FORK COMPRESSOR	2.32 FRONT FORK, Disassembly
HD-45966	FRONT FORK COMPRESSOR	2.32 FRONT FORK, Disassembly
HD-45966	FRONT FORK COMPRESSOR	2.32 FRONT FORK, Assembly
HD-46503	OIL LINE REMOVER	5.9 OIL LINE FITTINGS, Removal
HD-46503	OIL LINE REMOVER	5.10 RADIATOR AND OIL COOLER, Removal
HD-46582	COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER	6.5 COUNTERBALANCER BEARING REPLACEMENT, Removal

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Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-47175	SWINGARM BEARING INSTALLATION TOOL	2.37 REAR FORK, Disassembly and Assembly
HD-47175	SWINGARM BEARING INSTALLATION TOOL	2.37 REAR FORK, Disassembly and Assembly
HD-47176	SWINGARM GUIDE	2.37 REAR FORK, Installation
HD-47181	ANGLE BLADE FEELER GAUGE SET	1.20 VALVE LASH, Lash Measurement
HD-47189	PISTON PIN REMOVAL AND INSTALLATION TOOL	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-47189	PISTON PIN REMOVAL AND INSTALLATION TOOL	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-47852	INNER FORK NUT REMOVER/INSTALLER	2.32 FRONT FORK, Disassembly
HD-47852	INNER FORK NUT REMOVER/INSTALLER	2.32 FRONT FORK, Assembly
HD-48114	TERMINAL REMOVER	A.18 MOLEX MX 150 SEALED CONNECTORS, Molex MX 150 Sealed Connector Repair
HD-48119	TERMINAL CRIMPER	A.18 MOLEX MX 150 SEALED CONNECTORS, Crimp Terminal to Lead
HD-48287	TRIPLE TREE WEDGE TOOL	2.32 FRONT FORK, Removal
HD-48287	TRIPLE TREE WEDGE TOOL	2.32 FRONT FORK, Installation
HD-48287	TRIPLE TREE WEDGE TOOL	2.33 STEERING HEAD, Installation
HD-48625	CLUTCH HUB HOLDER	6.3 CLUTCH, Removal
HD-48625	CLUTCH HUB HOLDER	6.3 CLUTCH, Removal
HD-48625	CLUTCH HUB HOLDER	6.3 CLUTCH, Installation
HD-48650	DIGITAL TECHNICIAN II	2.21 BLEEDING BRAKES, Procedure
HD-48650	DIGITAL TECHNICIAN II	4.13 FUEL PRESSURE TEST, General
HD-48650	DIGITAL TECHNICIAN II	7.33 H-DSSS ACTUATION, Fob Assignment
HD-48650	DIGITAL TECHNICIAN II	C.2 ABS MODULE, Installation
HD-48650	DIGITAL TECHNICIAN II	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
HD-48650	DIGITAL TECHNICIAN II	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
HD-48650	DIGITAL TECHNICIAN II	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module
HD-48650	DIGITAL TECHNICIAN II	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
HD-48921	REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921	REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-2	BASE	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-2	BASE	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-3	DRIVER	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-3	DRIVER	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-4	SLEEVE	2.26 REAR WHEEL, Cleaning and Inspection
HD-48921-4	SLEEVE	2.26 REAR WHEEL, Cleaning and Inspection

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Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-50120	UNIVERSAL CRIMPER SET	A.16 JAE MX19 SEALED CONNECTORS, Crimping Terminals
HD-50120	UNIVERSAL CRIMPER SET	A.17 MOLEX CMC SEALED CONNECTORS, Crimping Terminals
HD-50120-2	HAND CRIMP FRAME	A.16 JAE MX19 SEALED CONNECTORS, Crimping Terminals
HD-50120-2	HAND CRIMP FRAME	A.17 MOLEX CMC SEALED CONNECTORS, Crimping Terminals
HD-50120-3	JAE DIE	A.17 MOLEX CMC SEALED CONNECTORS, Crimping Terminals
HD-50120-4	JAE DIE	A.17 MOLEX CMC SEALED CONNECTORS, Crimping Terminals
HD-50120-6	JAE DIE	A.16 JAE MX19 SEALED CONNECTORS, Crimping Terminals
HD-50423	0.6 MM TERMINAL EXTRACTOR TOOL	A.17 MOLEX CMC SEALED CONNECTORS, Molex CMC Sealed Connectors
HD-50424	1.5 MM TERMINAL EXTRACTOR TOOL	A.17 MOLEX CMC SEALED CONNECTORS, Molex CMC Sealed Connectors
HD-59000B	OIL LEVEL GAUGE	2.32 FRONT FORK, Assembly
HD-59000B	OIL LEVEL GAUGE	2.32 FRONT FORK, Assembly
HD-94820-75A	REAR SHOCK SPANNER WRENCH	1.18 SUSPENSION ADJUSTMENTS, Shock Absorbers
HD-95637-46A	UNIVERSAL WEDGE ATTACHMENT	2.33 STEERING HEAD, Cleaning and Inspection
HD-96333-105	PISTON RING COMPRESSOR	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
HD-99500-80	WHEEL TRUING AND BALANCING STAND	2.28 CHECKING CAST WHEEL RUNOUT, Checking Wheel Runout
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER	2.21 BLEEDING BRAKES, Procedure
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER	C.2 ABS MODULE, Installation
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER	2.15 SECONDARY CLUTCH ACTUATOR, Installation
SNAP-ON BB200A	BASIC VACUUM BRAKE BLEEDER	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
SNAP-ON BB200A OR EQUIVALENT	BASIC VACUUM BRAKE BLEEDER	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module
SNAP-ON BB200A OR EQUIVALENT	BASIC VACUUM BRAKE BLEEDER	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
SNAP-ON CJ2001	METRIC BOLT GRIP PULLER SET	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
SNAP-ON CJ2001	METRIC BOLT GRIP PULLER SET	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End
SNAP-ON CJ2001	METRIC BOLT GRIP PULLER SET	6.10 DRIVE SPROCKET FLANGE, Replacement
SNAP-ON DC2001	METRIC BOLT GRIP PULLER SET	6.10 DRIVE SPROCKET FLANGE, Replacement
SNAP-ON SDD1410	SCREWDRIVER	5.7 COOLANT PIPES AND HOSES, Removal
SNAP-ON SDD1410	SCREWDRIVER	5.7 COOLANT PIPES AND HOSES, Installation
SNAP-ON SDD1410	LONG THIN SCREWDRIVER	5.10 RADIATOR AND OIL COOLER, Removal
SNAP-ON SRPC3890	RETAINING RING PLIERS	6.5 COUNTERBALANCER BEARING REPLACEMENT, Removal

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
SNAP-ON TA360	TORQUE ANGLE GAUGE	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
SNAP-ON TA360	TORQUE ANGLE GAUGE	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
SNAP-ON TA360	TORQUE ANGLE GAUGE	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation
SNAP-ON TA360	TORQUE ANGLE GAUGE	3.10 CYLINDER HEAD, Installation
SNAP-ON TA360	TORQUE ANGLE GAUGE	6.4 TRANSMISSION, Assembly
SNAP-ON TT600-3	SNAP-ON PICK	A.6 DELPHI 630 METRI-PACK UNSEALED CONNECTORS, Delphi 630 Metri-Pack Unsealed Connector Repair
SNAP-ON TT600-3	SNAP-ON PICK	A.19 TYCO 070 MULTILOCK UNSEALED CONNECTOR, Tyco 070 Multilock Unsealed Connector Repair
YA8230	SNAP-ON VALVE STEM SEAL PLIERS	3.10 CYLINDER HEAD, Disassembly

DIGITAL TECHNICIAN® II HARLEY-DAVIDSON®

FASTENER	TORQUE VALUE		NOTES
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten to specification plus 90 degrees
* Connecting rod caps; specification plus 90 degrees	27 Nm	20 ft-lbs	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten to specification plus 90 degrees
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs	6.5 COUNTERBALANCER BEARING REPLACEMENT, Installation
* Counterbalancer gear fastener; specification plus 90 degrees	50 Nm	37 ft-lbs	6.4 TRANSMISSION, Assembly
* Cylinder head bolts; first torque then loosen one turn	35 Nm	26 ft-lbs	3.10 CYLINDER HEAD, Installation/Loosen one full turn then final tighten.
* Cylinder head bolts; second torque	20 Nm	15 ft-lbs	3.10 CYLINDER HEAD, Installation/Tighten to specification plus an additional 90 degrees
* Main bearing bolts; first torque then loosen one turn	25 Nm	18.4 ft-lbs	6.4 TRANSMISSION, Assembly/Loosen one full turn then final tighten.
* Main bearing bolts; second torque plus 90 degrees	15 Nm	131 **in-lbs**	6.4 TRANSMISSION, Assembly/Tighten to specification plus an additional 90 degrees
* Primary gear fasteners; specification plus 60 degrees	15 Nm	132 **in-lbs**	3.12 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation/Tighten in a crisscross pattern plus 60 degrees.
ABS module fasteners	4-6 Nm	35-53 **in-lbs**	C.2 ABS MODULE, ABS Module Service
ABS module fasteners	4-6 Nm	35-53 **in-lbs**	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
air bleed plug	9-11 Nm	80-97 **in-lbs**	5.5 THERMOSTAT, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.4 ENGINE COOLANT, Drain and Fill Cooling System
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.6 WATER PUMP, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Air bleed plug	9-11 Nm	80-97 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Air cleaner velocity stack screw	6 Nm	53 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Alternator cover fastener	9.7 Nm	86 **in-lbs**	7.19 ALTERNATOR, Installation
Alternator cover harness clip fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Assembly
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Alternator rotor bolt; first torque then loosen	83 Nm	61 ft-lbs	7.19 ALTERNATOR, Installation
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Alternator rotor bolt; second torque	180 Nm	132 ft-lbs	7.19 ALTERNATOR, Installation
Auxiliary volume screws	23 Nm	17 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Banjo bolt	23-31 Nm	17-23 ft-lbs	2.14 CLUTCH FLUID LINE, Installation
Banjo bolt	23-31 Nm	17-23 ft-lbs	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
Banjo bolt to ABS module	17.0-20.0 Nm	13.0-14.7 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module

FASTENER	TORQUE VALUE		NOTES
Banjo bolt to ABS module	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Banjo bolt to calipers	23-29 Nm	17-21.4 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Banjo bolt to master cylinder	17-20 Nm	12.5-14.7 ft-lbs	C.4 ABS BRAKE LINES, Front Master Cylinder to ABS Module
Banjo bolt to master cylinder	23-29 Nm	17-21.4 ft-lbs	C.4 ABS BRAKE LINES, Rear Master Cylinder to ABS Module
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Battery terminal	6.8-7.9 Nm	60-70 **in-lbs**	1.24 BATTERY MAINTENANCE, Installation/Connection
Battery terminal bolt	6.8-7.9 Nm	60-70 **in-lbs**	7.24 OIL PRESSURE SWITCH, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.4 LOWER FRAME RAILS, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.5 FRONT ENGINE MOUNT, Replacement
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.7 REAR ENGINE MOUNTS, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Battery terminal bolts	6.8-7.9 Nm	60-70 **in-lbs**	2.32 FRONT FORK, Installation
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**	6.9 DRIVE BELT, Replacement
Belt guard fasteners	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Belt guard grommet bolt	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Bleeder screws	23.0-26.0 Nm	17.0-19.2 ft-lbs	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
Bleed screw	9-11 Nm	80-100 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Bleed screw	9-11 Nm	80-100 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Bleed Screw	9-11 Nm	80-100 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Brake caliper bleeder valve	9.0-11.3 Nm	80-100 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Brake disc bolts, front	22-23 Nm	16-24 ft-lbs	2.25 FRONT WHEEL, Assembly
Brake disc bolts, rear	41-53 Nm	30-38 ft-lbs	2.26 REAR WHEEL, Assembly
Brake line banjo bolt, front caliper	23-26 Nm	17-19 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Brake line clamp fastener (to frame)	6-10 Nm	53.1-88.4 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Brake line clamp fasteners (to rear fork)	5-7 Nm	44.2-61.9 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Rear Brake Caliper
Bright hose clamp	3-4 Nm	27-35 **in-lbs**	5.6 WATER PUMP, Installation
Caliper pad pin	8.5-11.5 Nm	75-102 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Cam chain tensioner, secondary	100 Nm	74 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing

FASTENER	TORQUE VALUE		NOTES
Cam chain tensioner, secondary	100 Nm	74 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam cover fasteners	11 Nm	97 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Cam cover fasteners	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Cam cover fasteners	11 Nm	97 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing/Special method: Install in sequence: cable straps first, spark plug hole gasket second
Cam journal caps	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Cam journal caps	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam journal caps	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Cam journal caps	9.7 Nm	86 **in-lbs**	3.10 CYLINDER HEAD, Head Assembly
Camshaft sprocket fasteners	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Center mounting bolt	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Clamp and bright clamp	3-4 Nm	27-35 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**	2.14 CLUTCH FLUID LINE, Installation
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Clutch hub nut	220 Nm	162 ft-lbs	6.3 CLUTCH, Installation
Clutch inspection cover	6-10 Nm	53-88 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Clutch master cylinder/reservoir, banjo bolt	17-20 Nm	13-14 ft-lbs	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Clutch master cylinder/reservoir, reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Clutch reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Clutch side crankcase cover fasteners	9.7 Nm	86 **in-lbs**	6.3 CLUTCH, Installation
Coil fasteners	9.7 Nm	86 **in-lbs**	1.15 SPARK PLUGS AND COIL, Installation
Compensator bowl screws (final torque)	102-115 Nm	75-85 ft-lbs	2.26 REAR WHEEL, Assembly
Compensator bowl screws (initial torque)	75-88 Nm	55-65 ft-lbs	2.26 REAR WHEEL, Assembly
Coolant air bleed plug	9-11 Nm	80-97 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling fan fasteners	5-7 Nm	44-62 **in-lbs**	7.27 COOLING FANS, Installation
Cooling system, cross member fasteners	20-26 Nm	15-19 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Cooling system, hose worm drive clamps	3-4 Nm	27-35 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, P-clamp	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, pipe clamp	6.5 Nm	57 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Cooling system, pipe connecting clamp	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation

FASTENER	TORQUE VALUE		NOTES
Cooling system, top mounting flange nuts	19-27 Nm	15-20 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Crankcase/transmission case fasteners	25 Nm	18.4 ft-lbs	6.4 TRANSMISSION, Assembly
Crank position sensor fastener	8.2-10.7 Nm	73-95 **in-lbs**	7.18 CRANK POSITION SENSOR (CKP), Installation
cross member fasteners	20-26 Nm	14.7-19.2 ft-lbs	7.27 COOLING FANS, Installation
Cross member fasteners	20-26 Nm	15-19 ft-lbs	5.10 RADIATOR AND OIL COOLER, Installation
Cross member mounting bolts	20-26 Nm	15-19 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Crossover TORCA clamp	13-15 Nm	115-133 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Cylinder head exhaust flange nuts, front	8-12 Nm	71-106 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Cylinder head exhaust flange nuts, rear	8-12 Nm	71-106 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	2.26 REAR WHEEL, Installation
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	2.35 BELT GUARD AND DEBRIS DEFLECTOR, Installation
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	6.9 DRIVE BELT, Replacement
Derby cover fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Installation
Drain plug, engine oil	35 Nm	25.8 ft-lbs	1.5 MAINTENANCE SCHEDULE, General
Drain plug, radiator	2.3-2.8 Nm	21-24 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Drive sprocket cover screws	6-10 Nm	53-88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Drive sprocket flange nut	160 Nm	118 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	6.4 TRANSMISSION, Assembly
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
ECT sensor	23 Nm	17 ft-lbs	5.8 ENGINE COOLANT TEMPERATURE SENSOR (ECT), Installation
Engine crankcase end of stabilizer link	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Engine mount bracket bolts	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount double threaded studs	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Installation
Engine mount double-threaded studs	34-41 Nm	25-30 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Engine mount to bracket	34-41 Nm	25-30 ft-lbs	2.6 FRONT ENGINE MOUNT ASSEMBLY, Disassembly And Assembly
Exhaust bracket stud plate fasteners	19-27 Nm	14-20 ft-lbs	4.15 EXHAUST SYSTEM: VRSCF, Installation
Exhaust flange nuts	8-12 Nm	71-106 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Fender, inner fasteners	95-110 Nm	75-81 ft-lbs	2.39 REAR FENDER, Installation
Fender light assembly: VRSCDX (rear)	1.5-2.0 Nm.	13.2-17.7 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
Fender mounting fasteners	20-26 Nm	15-19 ft-lbs	2.39 REAR FENDER, Installation
Fender to fork brace, front	4.1-6.8 Nm	36-60 **in-lbs**	2.31 FRONT FENDER, All Models/Tighten in cross pattern.
Flange nut, drive sprocket	160 Nm	118 ft-lbs	6.7 OUTPUT SHAFT, Disassembly: 2nd Gear End

FASTENER	TORQUE VALUE		NOTES
Footrest bracket/stud plate nuts	19-27 Nm	14-20 ft-lbs	2.10 PASSENGER FOOTRESTS, Passenger Footrests: VRSCF
Footrest bracket socket head capscrews	55-70 Nm	40-52 ft-lbs	2.10 PASSENGER FOOTRESTS, Passenger Footrests: All except VRSCF
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs	2.9 RIDER FOOTRESTS AND FOOT CONTROLS, Rider Footrests
Footrest clevis fastener	61-75 Nm	45-55 ft-lbs	2.9 RIDER FOOTRESTS AND FOOT CONTROLS, Rider Footrests
Fork and stem pinch bolts	41-48 Nm	30-35 ft-lbs	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Fork brace to forks, front	20-26 Nm	15-19 ft-lbs	2.31 FRONT FENDER, All Models
Fork cap	29-39 Nm	21.3-28.8 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap into fork
Fork cap	29-39 Nm	21.3-28.8 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap into fork
Fork cartridge fastener	15-25 Nm	132-221 **in-lbs**	2.32 FRONT FORK, Assembly
Fork stem bracket pinch bolts	41-48 Nm	30-35 ft-lbs	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Front and rear oil cooler fasteners	10-12 Nm	89-106 **in-lbs**	5.11 OIL COOLER, Installation
Front axle pinch bolt	55-65 Nm	41-48 ft-lbs	2.25 FRONT WHEEL, Installation
Front brake caliper bottom mounting bolt	43-52 Nm	32-38 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Front brake caliper top mounting bolt	43-52 Nm	32-38 ft-lbs	2.18 FRONT BRAKE CALIPER, Installation
Front brake hose bracket bolt	6-10 Nm	53-89 **in-lbs**	2.33 STEERING HEAD, Installation
Front brake master cylinder banjo bolt	17-20 Nm	13-15 ft-lbs	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Front brake master cylinder cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Front caliper pin	8.5-11.5 Nm	75-102 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Front cylinder secondary cam chain tensioner	100 Nm	74 ft-lbs	1.21 SECONDARY CAM CHAIN, Adjustment
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**	5.4 ENGINE COOLANT, Drain and Fill Cooling System
Front engine coolant drain plug	9.7 Nm	86 **in-lbs**	5.6 WATER PUMP, Removal
Front engine drain plug	9.7 Nm	86 **in-lbs**	2.8 ENGINE REPLACEMENT, Removal
Front engine mount bolts	34-41 Nm	25-30 ft-lbs	2.5 FRONT ENGINE MOUNT, Replacement
Front engine mount fastener	38 Nm	28 ft-lbs	1.20 VALVE LASH, Lash Adjustment
Front master cylinder reservoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Front wheel axle nut	81-99 Nm	60-73 ft-lbs	2.25 FRONT WHEEL, Installation
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel injector screws	2.0-2.8 Nm	18.0-25.0 **in-lbs**	4.9 FUEL INJECTORS, Assembly
Fuel rail bolts	9.7 Nm	86 **in-lbs**	4.5 THROTTLE BODY AND FUEL RAIL, Installation
Fuel tank mounting fasteners	40-48 Nm	30-35 ft-lbs	4.10 FUEL TANK, Installation
Grabstrap	20-26 Nm	14-19 ft-lbs	2.38 SEAT, Installation
Ground cable terminal ring nut bolt	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation

FASTENER	TORQUE VALUE		NOTES
Handlebar (VRSCDX), cast riser fasteners	41-47 Nm	31-35 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation
Handlebar (VRSCDX) clamp, front fasteners	16-20 Nm	12-15 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation/First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque.
Handlebar (VRSCDX) clamp, rear fasteners	16-20 Nm	12-15 ft-lbs	2.22 HANDLEBARS: VRSCDX, Installation/First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque.
Handlebar clamp and master cylinder housing screws	8-9 Nm	71-80 **in-lbs**	2.17 FRONT BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	7.29 RIGHT HANDLEBAR SWITCH, Installation/T25 TORX
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	7.30 LEFT HANDLEBAR SWITCH, Installation/T27 TORX
Handlebar clamp screws	8-9 Nm	71-80 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Handlebar housing screws	4.0-5.1 Nm	35-45 **in-lbs**	1.11 THROTTLE CABLES, Lubrication
Handlebars (VRSCF) bolts	41-47 Nm	31-35 ft-lbs	2.23 HANDLEBARS: VRSCF, Installation
Handlebar switch housing screw	4-5 Nm	35-45 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	7.29 RIGHT HANDLEBAR SWITCH, Installation/T25 TORX
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	7.30 LEFT HANDLEBAR SWITCH, Installation/T25 TORX
Head bolts, 6 mm	9.7 Nm	86 **in-lbs**	3.10 CYLINDER HEAD, Installation
Headlamp alignment fastener (typical)	4.5-7.5 Nm	40-66 **in-lbs**	1.22 HEADLAMP ALIGNMENT, Headlamp Adjustment
Headlamp bracket fastener	11-18 Nm	8-13 ft-lbs	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Headlamp bracket fasteners, VRSCF	11-18 Nm	108-156 **in-lbs**	2.23 HANDLEBARS: VRSCF, Installation
Heat shield screws	10 Nm	88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Hex-nut	6-10 Nm	53-88 **in-lbs**	7.10 STARTER, Installation
Hex-nuts	6-10 Nm	53-88 **in-lbs**	7.11 STARTER SOLENOID, Installation
Horn assembly acorn nut	9-15 Nm	80-132 **in-lbs**	7.26 HORN, Replacement
Horn flange nut	6-8 Nm	53-70 **in-lbs**	7.26 HORN, Replacement
Hose clamps	3-4 Nm	27-35 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Hose cover	3-4 Nm	27-35 **in-lbs**	5.6 WATER PUMP, Installation
IAC screws	2-4 Nm	25-35 **in-lbs**	4.6 IDLE AIR CONTROL (IAC), Installation
Ignition/light switch fasteners	4-7 Nm	35-62 **in-lbs**	7.12 IGNITION/HEADLAMP KEY SWITCH, Replacement
Inner fork nut	93-113 Nm	69-83 ft-lbs	2.32 FRONT FORK, Assembly/Hand tighten. Then tighten to torque.
Input bearing retainer fasteners	23 Nm	17 ft-lbs	6.4 TRANSMISSION, Assembly
Instrument cluster housing fasteners	4-7 Nm	35.4-62.0 **in-lbs**	2.23 HANDLEBARS: VRSCF, Installation

FASTENER	TORQUE VALUE		NOTES
Instrument cluster housing screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Instrument cluster screws	4.1-6.8 Nm	36.3-60.2 **in-lbs**	7.21 INSTRUMENT CLUSTER: VRSCF, Installation
Instrument cluster to housing fasteners	1.3-1.9 Nm	12-16 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
Instrument housing hinge fastener	2.2-2.8 Nm	20-24 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
Intake hose clamps	1.25 Nm	11 **in-lbs**	4.5 THROTTLE BODY AND FUEL RAIL, Installation
Jiffy stand anchor	7-9 Nm	62-79 **in-lbs**	2.41 JIFFY STAND, Installation
License plate bracket fasteners (VRSCF) (Non-DOM)	8-12 Nm	70.7-106.1 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Non-Domestic
License plate bracket fasteners (VRSCF-DOM)	9-11 Nm	80-97 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Domestic Only
license plate lamp fasteners (VRSCDX)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
Locking bolts	88-102 Nm	65-75 ft-lbs	6.9 DRIVE BELT, Replacement
Locking bolts	88-102 Nm	65-75 ft-lbs	6.10 DRIVE SPROCKET FLANGE, Replacement
Lower frame rail bolts	61-75 Nm	45-55 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Lower frame rail bolts (final torque)	61-75 Nm	45-55 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Lower frame rail bolts (initial torque)	61-75 Nm	45-55 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Lower muffler clamp	65 Nm	48 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Lower muffler screws	23 Nm	17 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
MAP sensor bracket bolt	6.0-10.0 Nm	53-88 **in-lbs**	4.7 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP), Installation
Master cylinder reservoir cover	1.1-1.4 Nm	10-12 **in-lbs**	1.5 MAINTENANCE SCHEDULE, General
Mirror adjustment fastener	11-13 Nm	97-115 **in-lbs**	7.17 TURN SIGNALS: VRSCF, Turn Signal Replacement
Muffler heat shield fasteners	2.3-4.5 Nm	20-40 **in-lbs**	4.15 EXHAUST SYSTEM: VRSCF, Installation
Muffler inlet endcap screws	0.6 to 1.2 Nm	5.3 to 10.6 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Muffler outlet endcap screws	1.7 to 2.3 Nm	15.0 to 20.3 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Muffler TORCA clamps	52-58 Nm	38-43 ft-lbs	4.15 EXHAUST SYSTEM: VRSCF, Installation
Neutral switch	12.8-16.5 Nm	113-146 **in-lbs**	7.23 NEUTRAL SWITCH, Installation
Oil drain plug	35 Nm	25.8 ft-lbs	1.6 ENGINE OIL AND FILTER, Changing Oil and Filter
Oil drain plug	35 Nm	25 ft-lbs	2.8 ENGINE REPLACEMENT, Removal
Oil filter mount fasteners	9.7 Nm	86 **in-lbs**	3.14 OIL FILTER MOUNT, Removal/Installation
Oil line fittings	25.5-33.0 Nm	18.8-24.3 ft-lbs	5.9 OIL LINE FITTINGS, Installation
Oil line manifold fasteners	8-10 Nm	71-88 **in-lbs**	5.11 OIL COOLER, Installation
Oil pan fasteners	9.7 Nm	86 **in-lbs**	6.4 TRANSMISSION, Assembly
Oil pickup fasteners	9.7 Nm	86 **in-lbs**	6.4 TRANSMISSION, Assembly
Oil pressure switch	10.8-13.6 Nm	96-120 **in-lbs**	7.24 OIL PRESSURE SWITCH, Installation
Oil pump fasteners	9.7 Nm	86 **in-lbs**	3.13 OIL PUMP, Removal/Installation
Oxygen sensor	16.5-19.5 Nm	12-14 ft-lbs	4.8 OXYGEN SENSOR, Installation
Oxygen sensor bracket nut	8-10 Nm	71-88 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation

FASTENER	TORQUE VALUE		NOTES
Oxygen sensor heat shield bracket	8-12 Nm	71-106 **in-lbs**	4.8 OXYGEN SENSOR, Installation
Passenger pillion fasteners	6-10 Nm	53-88 **in-lbs**	2.39 REAR FENDER, Installation
P-clamp	6-10 Nm	53-88 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
P-clamp	6-10 Nm	53-88 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Pillion mounting nut	6-10 Nm	53-88 **in-lbs**	2.38 SEAT, Installation
Pipe clamp	6.5 Nm	57 **in-lbs**	5.7 COOLANT PIPES AND HOSES, Installation
Pipe clamp	6.5 Nm	57 **in-lbs**	5.10 RADIATOR AND OIL COOLER, Installation
Pipe clamp and P-clamp fasteners	6-10 Nm	53-88 **in-lbs**	5.5 THERMOSTAT, Installation
Pivot shaft nut	61-75 Nm	45-55 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Pivot shaft nut	61-75 Nm	45-55 ft-lbs	2.37 REAR FORK, Installation
Primary chain fixed tensioner fastener	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Primary chain hydraulic tensioner fasteners	9.7 Nm	86 **in-lbs**	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Radiator cover fasteners	4.1-6.8 Nm	36-60 **in-lbs**	7.27 COOLING FANS, Installation
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	5.5 THERMOSTAT, Removal
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	5.6 WATER PUMP, Removal
Radiator front cover fasteners	4.1-6.8 Nm	36.3-60.1 **in-lbs**	7.7 VOLTAGE REGULATOR, Installation
Radiator hose fasteners	9.7 Nm	86 **in-lbs**	1.20 VALVE LASH, Lash Adjustment
Radiator mounting nuts	19-27 Nm	14-20 ft-lbs	5.10 RADIATOR AND OIL COOLER, Installation
Radiator oil line bracket fastener	8-10 Nm	71-88 **in-lbs**	5.11 OIL COOLER, Installation
Radiator side cover fastener	3-4 Nm	27-35 **in-lbs**	1.16 RADIATOR SIDE COVERS, Installation
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.19 ALTERNATOR, Installation
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.27 COOLING FANS, Installation
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	7.27 COOLING FANS, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	1.10 DRIVE BELT AND SPROCKETS, Checking and Adjusting Drive Belt Deflection
Rear axle nut	190-203 Nm	140-150 ft-lbs	2.8 ENGINE REPLACEMENT, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	2.26 REAR WHEEL, Installation
Rear axle nut	190-203 Nm	140-150 ft-lbs	6.9 DRIVE BELT, Replacement
Rear brake caliper banjo bolt	23-26 Nm	17-19 ft-lbs	2.20 REAR BRAKE CALIPER, Installation
Rear brake caliper fastener	58-66 Nm	43-48 ft-lbs	2.20 REAR BRAKE CALIPER, Removal
Rear brake master cylinder banjo bolt	23-26 Nm	17-19 ft-lbs	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear brake master cylinder jam nut	41-54 Nm	30-40 ft-lbs	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear brake reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.19 REAR BRAKE MASTER CYLINDER AND RESERVOIR, Installation
Rear engine mount fasteners	34-41 Nm	25-30 ft-lbs	2.7 REAR ENGINE MOUNTS, Installation
Rear exhaust pipe to auxiliary volume clamp	13-17 Nm	115-150 **in-lbs**	4.14 EXHAUST SYSTEM: VRSCDX, Installation
Rear master cylinder reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.21 BLEEDING BRAKES, Procedure
Reservoir banjo bolt	23-31 Nm	17-23 ft-lbs	2.16 BLEEDING CLUTCH FLUID LINE , Procedure

FASTENER	TORQUE VALUE		NOTES
Reservoir cap screws	0.7-0.9 Nm	6-8 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Reservoir cap screws	1.1-1.4 Nm	10-12 **in-lbs**	1.14 BRAKE PADS AND DISCS, Brake Pad Replacement
Reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Resevoir cover screws	1.1-1.4 Nm	10-12 **in-lbs**	2.18 FRONT BRAKE CALIPER, Installation
Retainer nut, left side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap against retainer nut
Retainer nut, right side fork cap	17.5-22.5 Nm	12.8-16.6 ft-lbs	2.32 FRONT FORK, Assembly/Fork cap against retainer nut
Screw	6-10 Nm	53.0-88.4 **in-lbs**	C.4 ABS BRAKE LINES, ABS Module to Front Brake Calipers
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Secondary clutch actuator, bleed screw	9-11 Nm	80-97 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	2.16 BLEEDING CLUTCH FLUID LINE , Procedure
Secondary clutch actuator cover fasteners	6-10 Nm	53-88 **in-lbs**	6.3 CLUTCH, Installation
Secondary clutch actuator cover mounting bolts	6-10 Nm	53-88 **in-lbs**	2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation
Secondary clutch actuator crankcase cover fasteners	10 Nm	88 **in-lbs**	6.3 CLUTCH, Installation
Secondary clutch actuator fasteners	10 Nm	88 **in-lbs**	2.15 SECONDARY CLUTCH ACTUATOR, Installation
Shifter arm clamp bolt	14-16 Nm	132-144 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Shifter linkage to shifter arm bolt	9-15 Nm	80-133 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
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Shock mount fasteners	41-68 Nm	31-50 ft-lbs	2.36 REAR SHOCK ABSORBERS, Installation
Side cover fastener	4.1-6.8 Nm	36-60 **in-lbs**	7.6 MAIN FUSE, Replacement
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**	1.7 AIR CLEANER AND EXHAUST SYSTEM, Installation
Side cover fasteners	4.1-6.8 Nm	36.3-60.2 **in-lbs**	6.9 DRIVE BELT, Replacement
Solenoid cable terminal ring	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Spark plugs	23 Nm	17 ft-lbs	1.5 MAINTENANCE SCHEDULE, General
Spark plugs	23 Nm	17 ft-lbs	1.15 SPARK PLUGS AND COIL, Installation
Spark plugs	23 Nm	17 ft-lbs	1.20 VALVE LASH, Lash Adjustment
Spark plugs	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing
Spring screws	9.7 Nm	86 **in-lbs**	6.3 CLUTCH, Assembly
Spring washers	22-33 Nm	16-24 ft-lbs	2.25 FRONT WHEEL, Assembly
Stabilizer link ball end lock nuts (2)	34-41 Nm	25-30 ft-lbs	2.30 WHEEL ALIGNMENT, Centering Engine
Stabilizer link to frame tab fastener	34-41 Nm	25-30 ft-lbs	2.30 WHEEL ALIGNMENT, Centering Engine

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Stabilizer to frame tab	34-41 Nm	25-30 ft-lbs	2.4 LOWER FRAME RAILS, Installation
Starter limiter assembly fastener	46 Nm	34 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
Starter mounting bolts	9.8 Nm	86.7 **in-lbs**	7.10 STARTER, Installation
Starter solenoid mounting	6-10 Nm	53-88 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Stator mounting fastener	8.2-10.7 Nm	72-95 **in-lbs**	7.19 ALTERNATOR, Assembly
Steering stem bolt	9.5 Nm	84 **in-lbs**	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Steering stem bolt	9.5 Nm	84 **in-lbs**	1.19 STEERING HEAD BEARINGS, Adjustment (Fall-Away)
Steering stem pinch bolt (initial torque)	34 Nm	25.0 ft-lbs	2.32 FRONT FORK, Installation
Steering stem pinch bolt (second step)	8-11 Nm	70.8-97.3 **in-lbs**	2.32 FRONT FORK, Installation
Stoplamp switch	8.5-11.5 Nm	75.2-101.7 **in-lbs**	7.25 REAR STOPLIGHT SWITCH, Installation
Stud plate nuts	8-12 Nm	70.7-106.1 **in-lbs**	2.40 LICENSE PLATE BRACKET: VRSCF, Installation: Non-Domestic
Tail lamp screws	1.5-2 Nm	13-18 **in-lbs**	7.15 TAIL LAMP: VRSCF, Installation
Tail lamp screws: VRSCDX	1.5-2.0 Nm	13.3-17.7 **in-lbs**	7.14 TAIL LAMP: VRSCDX, Installation
Thermostat housing fasteners	9.7 Nm	86 **in-lbs**	5.5 THERMOSTAT, Installation
Thermostat lower hose clamp	3-4 Nm	27-35 **in-lbs**	5.5 THERMOSTAT, Installation
Throttle body clamp fasteners	1.25 Nm	11 **in-lbs**	2.8 ENGINE REPLACEMENT, Installation
Throttle housing screws	4-5 Nm	35-45 **in-lbs**	2.11 THROTTLE CABLES, Assembly and Installation
Top housing fastener	2.2-2.8 Nm	20-24 **in-lbs**	7.20 INSTRUMENT CLUSTER: VRSCDX, Installation
Top plate fasteners	5-6 Nm	44-53 **in-lbs**	4.11 FUEL MODULE ASSEMBLY, Installation
TP sensor screws	2.0-2.8 Nm	18-25 **in-lbs**	4.3 THROTTLE POSITION SENSOR (TP), Installation
Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
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Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
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Triple clamp pinch bolts	41-47 Nm	30-35 ft-lbs	2.32 FRONT FORK, Installation
Triple sprocket fastener	23 Nm	17 ft-lbs	3.9 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation
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Turn signal fasteners: VRSCDX (rear)	1.1-2.3 Nm.	9.7-20.3 **in-lbs**	7.16 TURN SIGNALS AND RUNNING LIGHTS: VRSCDX, Lamp Replacement
upper cooling fan fastener	19-27 Nm	14.0-19.9 ft-lbs	7.27 COOLING FANS, Installation
Upper muffler clamp	65 Nm	48 ft-lbs	4.14 EXHAUST SYSTEM: VRSCDX, Installation
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Valve stem nut	1.4-1.7 Nm	12-15 **in-lbs**	2.29 TIRES, Installation
Velocity stack fasteners	6 Nm	53 **in-lbs**	1.7 AIR CLEANER AND EXHAUST SYSTEM, Installation

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VSS mounting fastener	8.2-10.7 Nm	73-95 **in-lbs**	7.22 VEHICLE SPEED SENSOR (VSS), Installation
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